Me

how to make electronic music

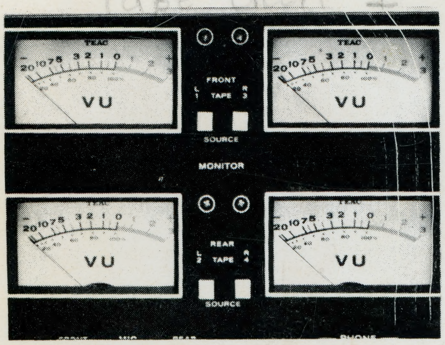
TECHNO

RUSH

...So far Lives...

tape experiments

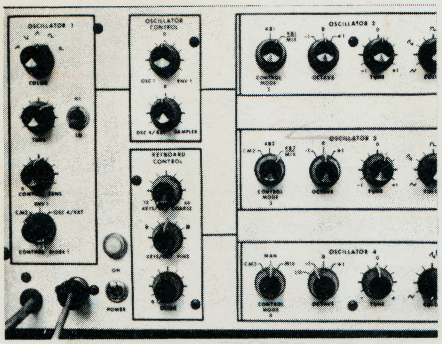
Tape deck 1



recording

eggo stiks

composing projects



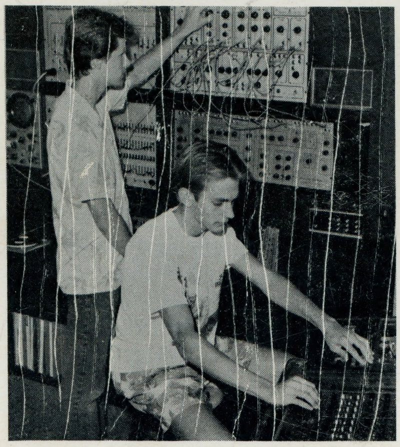
synthesizer experiments

tape techniques

technical information

what's this thing do?

the synthesizer



Prepared for the
ELECTRONIC MUSIC CLASSES
of the
Audubon High School
Audubon, New Jersey

3

Technician

Challenge

Electronic Music Will Never Make Me Cry!

I cannot forget the night our family attended a religious concert when I was just a teenager. The featured performer was a violinist of great distinction. He had given up a promising career in the 1950s in order to devote his life to the church. Quite honestly, our family attended for the sole purpose of hearing this man play.

The music was alive, unencumbered by any other mechanical device beyond the violin and bow. The hall was filled with the most glorious tones. Like individual, glistening raindrops, the notes shimmered and glowed. They hung in the air, pure and perfect.

My sister trembled with unspeakable emotion, the tears falling unheeded into her lap. At the conclusion, several gray-haired ladies came to her. They were so solicitous, so gentle and loving. It was all right. Her sins were forgiven. Wouldn't she like to make a commitment to the Lord? No?

They never quite understood that you cannot institutionalize the power of music. It may be a message from heaven, but it comes straight from the heart of the artist to the heart of the listener.

The performance of that evening, so vividly remembered even after 30 years, cannot be compared to the electronic music we hear so frequently today. The vocalists, bristling with microphones and earphones, the studio musicians, cocooned inside their sound-proofed booths, the synthesizers, the busy technicians burdened with electrical paraphernalia – they are so removed, so distant, so contrived. The multiple sound tracks, echoing voices, integrated circuits, digital recordings are all technically impressive; but they lack spontaneity and soul. One cannot help but wonder what happens to the music when the power fails. What is there to applaud when we hear the 2,000th copy of the 14th take that is finally just right?

The creation of live, acoustic music – that brings tears of joy to my eyes. I can feel the emotion. I can see the concentration. I can hear the unique quality of tone, the timbre of the instruments, the slight, overlaying touches of human breath and human fingertips. When it's perfect, it's overwhelming! It's the first and only "take" and I am there.

While at a youth orchestra performance, I feel the old emotions stir again. My throat is constricted; my heart swells. There are no programmed rhythms, no synthetic notes. This is the real thing. These are students who care about music. They practice. They sweat. They go for lessons. Whether satisfied or not with the result, they are exhilarated by the accomplishment. They are the ones making it happen. Their efforts are creating a performance that would not exist otherwise.

Every sound, perfect or imperfect, comes from a living, palpitating human being. Each instrument is tuned and adjusted. Each musical piece is a miracle of cooperation – musicians listening to each other and watching the graceful body language of the director. Every thinking, performing youngster is contributing an individual part to the harmonious whole. It is magic.

Over there is an eight-year-old violinist, her sweet Oriental face a picture of sober concentration. There is the dark-haired exchange student from South America, happily participating in the language of music, expressed far more eloquently than her limited English. On the left is the boy who last week won the regional math competition, but today is demonstrating his skill in the arithmetic of musical rhythm. In the back row is a trumpet player who has just qualified for three different scholarships because of his musical excellence. Face after face reminds me of the human story behind each player, the years of practice, the encouragement of teachers, directors and parents, and the obvious feeling of self-worth. It is this human dimension that enhances the music and elicits an emotional response in me.

Recently, I spoke with a friend in the recording industry who explained that one of the latest techniques is to program into the synthesized music a slight hesitation or a small imperfection in order to make it sound more human. Why, I wondered, did they not simply hire real musicians?

Well, we know the answer. It's cheaper and more efficient to use electronics. Technology makes it possible to create and mix an infinite variety of sounds. Somehow, though, it all seems so robotic, so lacking in human feeling.

Perhaps there is still hope. Sometimes recording studios, composers, and arrangers use electronics in order to find out just how the music should be played and how the parts fit together. Then they use thinking, feeling, gifted musicians for the final taping.

It's not that I believe there is no place for electronics in the field of music. It's just that there is a distinction in my mind between electronically created music and electronically recorded music. Advanced technology has made it possible for me to hear, without ever leaving my home, Vladimir Horowitz in Moscow,

continued

continued from page 80

Christopher Parkening in Los Angeles, and musicians long dead whose legacy of music has been faithfully preserved. I can enjoy symphonies, jazz, pops, opera, ballet – anything I wish – simply with the push of a button. I can hear it in stereo or watch it on video. I fully appreciate those marvelous accomplishments of human invention; but when all is said and done (or, played and heard), the closer the music is to the original, natural, acoustic sound, the more it will pull at my heartstrings.

There are, of course, some electronically produced sounds that have their own value and identity. Used creatively, these have become a part of "New Age" music. The Windham Hill recordings and the works of Andreas Vollenweider are excellent examples of this.

What I object to is the dehumanized precision and artificial imitations of electronic music. The sound of a flute, miraculously reproduced at the touch of one finger, is an astonishing phenomenon, scientifically speaking; but in the scale of human values, it is a cheat. Where is the person, the individual who practiced and struggled and learned how to master the intricacies of that instrument? Where is the self-discipline, the delayed gratification, the patience and persistence, the inner motivation? Where are the little nuances that create a dynamic, living performance? Where is the emotion, the heart, the feeling? Not there. Those human qualities cannot be packaged inside a mechanical device, however sophisticated. Synthetic music may have its place in our present culture, but it will never touch my heart.

So bring on the orchestras, the marching bands, the drum and bugle corps, the pipe organs and choirs, and the magnificent and courageous solo performers – and let me be moved. Let me laugh and cry and dance and respond for the pure joy of it! ■

– Jennifer Zobelein
Thousand Oaks, California

Aesthetics Electronic music is very new and its aesthetics are speculative.

There are many reasons for the composition and enjoyment of music. The use of electronic music as an intellectual exercise, as an aid to religious worship, dramatic mood or dance, or in a spirit of play or experimentation, may be easily understood. The use of electronic music as pure music is less easily understood. To understand electronic music as pure music we must inquire into the nature and purpose of pure music.

Instrumental music which is not intended to accompany other activities, or not an experimental exercise, seeks to make external models of inner consciousness. Pure music seeks to create an ideal model in sound of our own interior rhythms. The external model is always incomplete; but convincing constructions of pure music enable the listener to escape briefly into the models.

We speak of "living" music, music that "transports" or "carries us away." We also speak of emotion and meaning in music when it is obvious that pure music does not have concrete meaning. The "meaning" of pure music is meaning itself, the experience of being. It is sound energy in motion and its meaning is the meaning of the relationships between these energies. It is an analog of the human experience of consciousness which constructs relationships both in the conscious (real) and in the subconscious (dream) world. Obviously such a model is useful in understanding and sometimes escaping ourselves; and we honor it proportionately to the perceived excellence, level of complexity, and usefulness of the model.

Only a few works of electronic music have succeeded as pure music. Time is necessary to assimilate an artistic revolution and to foster its growth. Electronics promises more powerful instruments for the generation, control and storage of sound than any previously available. These instruments will produce, in time, a music more pure, more powerful than any ever known.

Improvisation The art of improvisation is useful in the electronic studio. Composers of the eighteenth and nineteenth centuries often improvised. Beethoven was said to have been particularly skilled in this art. Today improvisation carries the connotation of unfinished work, and some composers try to avoid improvisation in their work in an electronic music studio. However, the role of improvisation in the electronic music studio is very different from improvisation in a live music presentation. The "fault" of improvisation, if there is one, is that an ill-conceived or poorly executed improvisation is immediately public and cannot be undone. This is not the case in tape music. What may begin as an improvisation ends as a completed work. The final work is not an improvisation but a carefully ordered and selected succession of sounds. As the composer moves from improvisation to the finished composition, the degree of improvisation is ever lower and the degree of control and skill ever higher. Each choice narrows further choice. The composer knows when the piece is finished because there are no more choices to make. No need of additional sounds, no need for removing sounds: the piece is finished.

Many composers plan each step of their composition. This method is valid but more useful to mature composers who are already skilled in the use of their equipment and can thus predict the outcomes of generations, filters, ring modulations, mixes, or whatever.

If the finished work is to be played in conjunction with live performers, or if the composer wishes to organize his work in advance, or leave a record of his working procedures, an electronic score is needed.

Electronic Music Classified by Sources and Media of Performance

The form which an electronic music composition takes, and the type of notation which is used, if any, are related to the sources of the sound and to the intended performance medium. The listing below includes current sources and media of performance for electronic music.

1. **Musique concrète.** Tape music using natural sounds as sources intended for *recorded* performance
2. **Traditional acoustic sound or other media synchronized with electronic music** intended for *recorded* reproduction
3. **Traditional acoustic sound or other media synchronized with electronic sound** intended for *concert* performance
4. **Electronic sound** used for the **imitation of acoustic sound—"switched on" synthesis techniques** intended for *recorded* performance
5. **Electronic sound** used for the **development of original sound timbres** intended for *recorded* performance
6. **Live electronic music**

Notation may be useful in all of the above, but it is a *requirement* of types 2 and 3 and often needed in 4 and 6.

Electronic Music and Live Performers: Synchronization

Synchronization of Live Performers to Tape

In a score designed for synchronization of live performers to tape, one or more lines of the score are allotted to a representational notation of the electronic music. Indications of this part are usually shown on a four- or five-line staff, and they follow the general contour of the sound. In many cases it is impossible to specify exact pitches. Noise is usually indicated by shaded areas. Dynamics may be the traditional marks, *ppp* to *fff*, or words, such as "loud" or "soft."

Simple ideograms are effective for cueing the performers. The visual cues used in the score must be easily understood (and the sounds which they represent should be easily heard), as shown in the extract from the author's *A Time to Every Purpose* (Figure 83). Scores of this type sometimes call for synchronization by means of a stopwatch. See the conclusion of the same work, in Figure 84, as an example. The time notation in seconds helps the conductor to synchronize live performers with the tape, in the absence of pulse relations.

Other scores use pulse relations combined with tape lengths. The composer assigns a basic length of tape as a pulse rate. The performer synchronizes his performance by following the pulse established in the electronic part. An example of this procedure is given in Figure 85.

Since our perception of time and pulse durations is very changeable, brief "cushions" of unmeasured time may be included, with the pulse rate being re-established afterwards. Figure 86 is an example of this.

Synchronization of Tape to Live Performers

In a score requiring synchronization of tape to live performers, one or more lines of the score is alloted to an electronic part with instructions to turn the tape on and off. Usually the operator of the tape follows the full score.

Notations of the tape part are representational. There is no requirement for strong cues to performers since the tape operator follows the rate and speed of the live performance. Synchronization can vary as live performance speed varies, and it is sometimes necessary to compose an electronic part in which exact synchronization may not be required.

The creation of the electronic part not intended for *exact* synchronization becomes a special compositional problem. If the composer wishes to create a score that sets a kind of general effect but with changing details in each performance, the synchronization of electronic and live portions becomes a matter of interest and pleasure. Since emphasis in musical training is placed upon precise realization of a score with accurate synchronization of all parts, some musicians are confused by less precise synchronization techniques. They are valid musical procedures, however, and present stimulating opportunities for flexibility in performance.

The tape part must be able to combine effectively with the sounds of live performers with a leeway of several seconds. The performers may be several seconds ahead or behind the tape materials depending on distance from cues and running time.

Some compositional solutions to this problem are the following: 1) the electronic part may consist of nondifferentiated sound without strongly articulated individual sounds; 2) the electronic part should not be pulsed; 3) each electronic section should be less than 60 seconds in length so that extreme loss of synchronization does not occur. Time must be provided in the music for the tape operator to reset the tape for the next cue. It is convenient for the beginning points of the tape sections to be separated by about 15 inches of leader tape. Adjustments in loudness volume may be made by the tape operator during performance to conform to score indications. Thus it is possible to perform exact synchronization of dynamic balance with only approximate duration synchronization.

In the musical extract shown in Figure 87 the music played by the band is traditionally notated. Tape beginning points are synchronized with the band by a tape operator. Tape materials are pulsed and after tape entry the conductor takes the tempo from the tape.

Exact Synchronization of Tape with Live Performers

Milton Babbitt has produced works in which both the live performers *and* the electronic tape are *exactly* synchronized and notated. Babbitt produces his electronic works on the RCA Synthesizer at the Columbia-Princeton Studio in New York City. The RCA Synthesizer is controlled by punched paper tape. Babbitt's music is organized by serial methods using equal temperament. It is possible to make a traditional musical score of such music and to synthesize it with complete accuracy. Others, including Donald Erb, have produced exact notation of electronic music with traditional pitch and rhythmic divisions, using keyboard performance on transistor synthesizers recorded on multi-channel recorders. Performers read the score in a traditional manner and synchronize their parts to the tape by pulse regulation, as in traditional music.

See Figures 88 and 89 for examples of works by Babbitt and Erb.

Synchronization of "Switched On" Recordings

Recording artists working in the "switched on" electronic music style use multiple channel tape recorders and synchronize each channel precisely. While listening to previously recorded channels in the selective synchronization playback mode, the performer records the next line on an unused channel. "Switched on" electronic music uses equal temperament and a traditional score. Additional drawings may be made to indicate synthesizer connections and settings for the production of various sounds. Each synthesizer studio usually prepares its own duplicated sheet for the notation of electronic connections and settings.

Live Electronic Music

Live electronic music is presently in an experimental state. Rock groups have pioneered in this area. They use hybrid electronic instruments such as guitars with electronic pickups, filters, reverb units, distortion generators (fuzz), amplifiers and speakers.

Experimental groups such as Musica Electronica Viva, Once in Ann Arbor, and individuals such as John Eaton, Gerald Shapiro, Larry Austin, Terry Riley, David Rosenboom, Gordon Mumma, and others who build and/or play their own electronic instruments are also pioneering in live electronic music.

Sometimes live electronic music performances are improvisations which do not require notation. Many performances can be classified as aleatory, a style in which sound relationships occur only by chance. Notation, except of electronic requirements and general performance directions (often verbal), is usually not required for chance electronic music.

Live electronic music arranged and notated for electronic music instruments is also in an experimental state today. Technical notation depends upon the instruments used. Representational notation is derived from traditional notation with the addition of new symbols to show new pitch and time divisions.

The reader who wishes to pursue the subject of notation of electronic music can investigate a proposal for a systematic common practice in *A Descriptive Notation for Electronic Music* by Brian Fennelly[2]. Fennelly carefully considers present practice and suggests a very useful method for technical notation.

Copyright Protection

It is no longer necessary to notate a sound recording in order to seek copyright protection in the United States. Public Law 92-140 makes it possible to copyright certain sound recordings, provided they are fixed or first published with the statutory copyright notice on or after February 15, 1972. Copyright is for 28 years and may be renewed for another period of 28 years.

Sound recordings which are not published should not be copyrighted. "Unpublished recordings may be protected by the common law against unauthorized use without any action in the copyright office."[4] "Publication generally means the sale, placing on sale, or public distribution of copies of the sound recording. Performance of a sound recording by playing it, even in public or on radio or television, ordinarily does not constitute publication in the copyright sense."[4]

The Moog Synthesizer

The rapid spread of electronic music studios throughout the world has been facilitated by the development of less costly (under $10,000) transistor synthesizers. The Moog and Buchla Synthesizers were the first of these.

In the fall of 1964, Robert A. Moog displayed a modest collection of electronic music modules at the New York Audio Engineering Society convention. Moog developed these in consultation with composers Herbert Deutsch and Myron Schaeffer. Moog became interested in electronic music while an engineering student at Cornell University, where he built Theremins in his apartment for extra income.

The Moog modules were purchased at the convention by Alwin Nikolais, New York choreographer and composer, who subsequently created prize-winning works for his dance company with them.

The Moog synthesizer evolved as composers conferred with Moog as to their needs. The Moog synthesizer utilizes voltage control throughout all appropriate modules, allowing for maximum control of signal processing by changes in a single parameter. The basic design of the Moog synthesizer became fundamental to most subsequent manufactured synthesizers but not the Buchla. The Moog is played by one or more keyboards, and/or a ribbon (resistance wire) controller, or external sequencers. The Moog became famous in 1968 with the widespread popularity of Walter Carlos' album *Switched on Bach.*[4]

COURSE REQUIREMENTS

ELECTRONIC MUSIC I

CLASSWORK

1. During the first two marking periods, students will learn the function of all tape and mixing equipment
2. During the third marking period, students will learn the function and operation of the synthesizer equipment.
3. The fourth marking period (and part of the third) will be devoted to the preparation and the listening of student made electronic music tape projects.

HOMEWORK

1. General homework will be based on textbook and laboratory manual reading, and the additional time that will be necessary to complete tape and synthesizer projects.
2. Students will be expected to spend additional time (above and beyond their assigned Lab.) in the Laboratory.

LABORATORY TIME

1. All Electronic Music students are assigned to one Lab period per week.
2. Students who miss their Lab due to being absent from school MUST make up the missed Lab after school or in the evening.

TESTS, QUIZZES and EXAMINATIONS

1. The majority of written tests will be given during the first two marking periods.
2. Tape and synthesizer projects will count as tests during the second, third and fourth marking periods.
3. A nine-week test will be given during the first three marking periods. These tests will be both written and project oriented. An extensive tape project will count as the nine-week test for the fourth marking period.
4. A very comprehensive Final Examination will be given at the end of the year. This examination will cover ALL material given during the entire school year and will be based on all of the written tests that have been given.

GRADING PROCEDURES (*)

First & Second Marking Periods

Average of all tests	22%
Tape projects	23%
(+)Effective Use of Lab time	22%
Nine-week test	33%

Third Marking Period

Tape & Synthesizer projects	34%
(+)Effective Use of Lab time	33%
Nine-week test	33%

Fourth Marking Period

3 Major Synthesizer projects	65%
(+)Effective Use of Lab time	35%

(+) Effective use of Laboratory time includes:

1. Good planning of the use of time
2. Care and respect of the equipment
3. General clean up at the end of the Lab
4. Seriousness of purpose

(*) GRADING PROCEDURES are subject to change depending upon school factors and class and individual progress that will be attained.

September, 1989

ELECTRONIC MUSIC LABORATORY

AUDUBON HIGH SCHOOL

EQUIPMENT AS OF SEPTEMBER, 1989

1 A. TEAC Quarter track, 4 channel Tape Deck with multiple select synchronization. No. 3440S

2 B. TEAC 6100 Mark II half-track master recorder into two channels (recording) with both two and four channel playback. Two and four track playback (mixed).

3 C. TEAC 2 channel, half track master tape deck 3300SX

D. PIONEER Double dubbing cassette deck CT-1040W

E. DUAL single play electric drive turntable Model CS721 with Shure VI5III cartridge

F. 4 KOSS Pro 4AAA Stereo headphones

G. SENNHEISER high polymer Stereophones

H. 2 PIONEER HPM 100 (100 watt) speakers

I. MARANTZ 180 DC stereo console power amplifier 90 watts per channel into 8 ohms

J. dbx Model 155 Noise reduction unit

K. TEAC-TASCAM Model 3 multitrack 8 input mixer with 8 input submixer.

ELECTROCOMP SYNTHESIZER

101 portable keyboard modular synthesizer with 4 VCO's.

200 Studio synthesizer with 3 VCO's

301 Manual controller with pushbutton keyboard 1 VCO.

400 Sequencer - 32 stage multiple sequential synthesizer with 2 self contained VCO's.

ASSOCIATED EQUIPMENT

TEAC ME-120 Electret Condenser microphone interchangeable from cardiod to omnidirectional

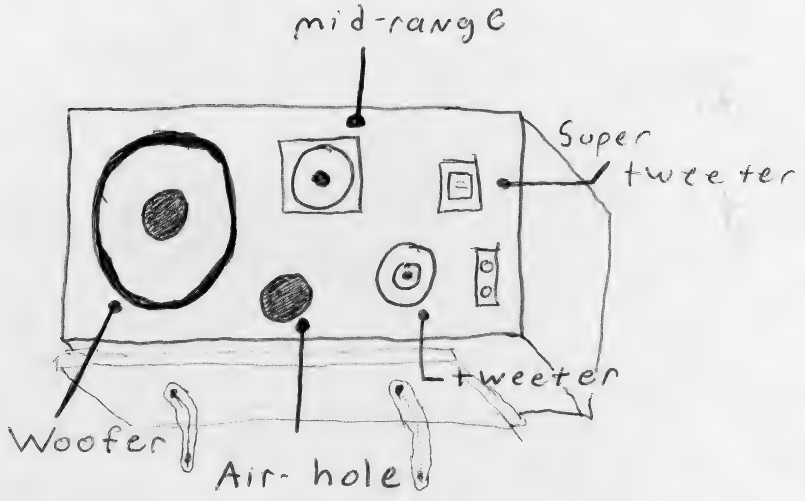
5 Mike input transformers ME-120

1 Bulk tape eraser

1 Digital class clock; 1 timing clock (60 minutes)

Remote control unit for TEAC tape decks

Splicing blocks, line cords, 6', 24", 18" patch cords, 3", 5", 7", 10" tape reels


mid-range
Super tweeter
tweeter
Woofer
Air-hole

GENERAL ACOUSTICAL & ELECTRONIC TERMS

Acoustics - the study of the science of sound

PITCH & FREQUENCY

High or low.

Frequency - meausered in Hrz.
human range is 16 to 18,000 Hrz

OCTAVE

An 8 note space which doubles in Hrz, as it goes up.

PARTIALS & OVERTONES

Pitches above the basic pitch

STEREO-CHANNELS

Sound from 2 speakers appearing to emitt from the middle.

a channel is a speaker.

AMPLITUDE - Volume

measure of how loud & not loud in decibels

Attenuate - decrease

POT - Knob

Faders & linier slides, And joysticks.

Potentiometer

BEATS

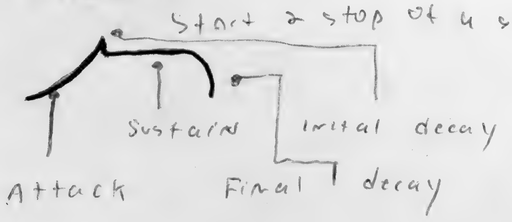
2 frequencies not exactly exact.

REVERB - a tendancy to run into each other

Echo - has a silence between it

ENVELOPE

Start & stop of a signal,



NOISE

Blue - low noise
white - regular
Pink - harsh

TIMBRE-FILTER

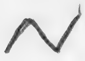
Filter - change the timbre/quality
(partials & overtones)

RESONANCE - PRESENCE

SIGNAL WAVES AVAILABLE

SINE HAS no overtones

TRIANGLE



- pure

SQUARE

- Richest

INVERTED PULSE

SAWTOOTH

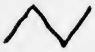
INVERTED SAWTOOTH

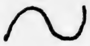
DOUBLE SAWTOOTH

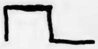
or

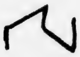
SLOPED SQUARE WAVE

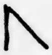
The following waveforms are found on all of the ELECTRCOMP Synthesizers found in our Lab.

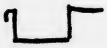
A.  - triangle - pure

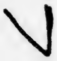
B.  - Sine - purest

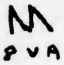
C.  - Square/Pulse

D.  - Slope Square wave

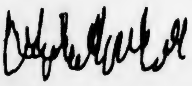
E.  - Sawtooth

101/osc 1 F.  - Inverted Pulse

101/osc 1 G.  - Inverted Sawtooth

H. 

- Double Sawtooth

I.  - Noise

REGULATIONS FOR USE OF ELECTRONIC MUSIC LABORATORY

SEPTEMBER

1. Technicians are to report, and be on time, for all scheduled Labs unless permission has been given by the Instructor PRIOR to the Lab involved.

2. As soon as you enter the Lab, "clock-in" on the time clock.

3. Use your time effectively. Have some idea as to what you are going to do prior to coming to the Lab. Make the most of the time that you have.

4. Allow yourself enough time at the end of the period for Lab clean-up. Be certain that all supplies, tape, patch cords, etc. are put back in their proper place. Clean up any splices or small pieces of tape. Place all empty reels back in the storage container.

5. Be certain to "clock-out" at the end of the period. If you do not "clock-in" or "out", you will not receive any credit for the time that you spent in the Lab.

GENERAL POINTS

1. All Electronic Music students should spend AT LEAST 45 minutes per week for an individual Lab.

   You may use the Lab during a Study Hall, or if there is a "sub" in one of your classes, you may come down during that time. Be sure to ask the "sub" for permission to come to the Lab BEFORE you come down. A note will be provided to the "sub" showing that you did in fact appear.

2. If for some reason there is no available time for you to come to the Lab during the school day, then you will have to plan some time after school in the Lab. After school time is given on a reservation basis at the discretion of the Instructor.

3. Only current are past Electronic Music students are permitted in the Lab either during or after school.

4. Eating, food or gum chewing IS NEVER PERMITTED in the Lab at any time.

5. The power for the Lab will always remain on for the entire week, 24 hours a day. Do not turn off the power to any units.

6. UNDER NO CIRCUMSTANCES are you to touch someone else's time card. You are not permitted to clock in or out as a "favor" for another technician.

7. THE LAB IS CLOSED FOR USE AT 2:30 PM ON FRIDAY'S OR DAYS BEFORE ANY VACATION. Do not plan to use it at that time.

LABORATORY TIME CARDS

YELLOW

To be used for "in-class" lab time, when given.

CARD NO. ______

		OUT	
		IN	Appr.
		OUT	
		IN	Appr.
		OUT	
		IN	Appr.
		OUT	
		IN	Appr.
		OUT	
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		IN	Appr.
		OUT	
		IN	Appr.
		OUT	
		IN	Appr.
		OUT	
		IN	

ELECTRONIC MUSIC LABORATORY CLASS CARD

______ M.P. ______ DATE TO ______ DATE

TOTAL TIME ______

WHITE

To be used for regular assigned Lab time and any extra time that is used.

Card No. ______

M.P. ______ Date ______ TO ______ Date ______ M.R.T. ______ Min.

ELECTRONIC MUSIC LABORATORY - AUDUBON HIGH SCHOOL

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TIME USED ______

OVER/SHORT ______

TAPE CONTROL IN ELECTRONIC MUSIC

PREPARED FOR THE

ELECTRONIC MUSIC CLASSES

OF THE

AUDUBON HIGH SCHOOL
Audubon, New Jersey

TAPE CONTROL IN ELECTRONIC MUSIC

A requirement for anyone considering creating electronic music is a familiarity with magnetic recording tape, tape recorders, and the techniques of basic tape recording, manipulation and control. Magnetic recording tape has been the method by which electronic music has been transformed and preserved and was the primary vehicle for early electronic compositions.

Magnetic tape is used to preserve sounds in the form of magnetic impulses. Tape, by nature of its base, coating, thickness, width, length and the recording process, is adaptable to a number of controls of the imprinted sound (called the 'signal'). It is the control of the signal that is important to the electronic music composer.

WHAT KIND OF TAPE RECORDER?

An important factor determining the amount of control possible in any given situation is the type and number of tape recorders available to the composer. Reel to reel, cartridge and cassette recorders are the three basic types of recorders in general use.

Cassette and cartridge recorders are designed primarily to preserve sound in as small a space as possible and generally do not have the flexibility of control necessary for electronic music. There may be some instances, however, where a sound to be used for 'musique concrete' manipulation may only be obtainable through use of a portable recorder. That signal may then be re-recorded (dubbed) onto a reel tape for further use. (See Direct Wire Recording.)

Reel to reel recorders come in a wide variety of format, design, and price. Well equipped electronic music studios include professional, multi-track recorders costing several thousands of dollars each but it is possible to do excellent work with recorders costing as little as $200 - $300. Points to consider in buying a tape recorder for electronic music use include:

1. heads and capstan drive must be accessible.
2. it must have separate record and playback heads in addition to the erase head (three head design).
3. pause control or instant stop is essential.

4. V.U. level indicating meters are essential
5. tape decks are more flexible than self-contained units (tape decks must be combined with a good quality amplifier and speakers).
6. a signal to noise ratio of 52db or higher is essential.
7. half track stereo units are ideal -- quarter track stereo and quadriphonic units are acceptable.
8. monaural recorders are useful as extra recorders for dubbing, mixing and splicing monaural signals.
9. avoid automatic features which are conveniences for 'easy listening' such as automatic reverse and automatic threading.

WHAT TYPE OF TAPE?

There is a wide variety of tapes manufactured for magnetic recording. They come in a variety of widths (1/4" is standard for many recorders), thicknesses, lengths, flexible backing materials and oxide coatings. A serious electronic music composer should take time to learn which combination of these factors will give the best results with the equipment available.

Because the electronic music composer must do more than the usual amount of handling of the tape (rewinding, fast forward, stopping, starting, splicing, etc.) he should choose a strong tape. A thickness of 1 1/2 mil of either acetate or polyester backing material gives the strength needed in most circumstances. Thinner acetate breaks too easily and thinner polyester stretches too easily.

The coating (dull side) on the backing material is a magnetically sensitive substance which is usually reddish brown in color. This coating consists of a layer of microscopically fine particles of metallic oxide. When passing the playback head of a recorder the oxide coating creates a 'hiss' which is called the inherent noise of the tape and cannot be entirely eliminated. Inherent noise can be a problem for the electronic music composer, especially if the recording equipment is not properly adjusted to suppress that noise ('bias' adjustment).

Oxide coatings come in a variety of formulae each having its own particular recording characteristics. These must match the recording characteristics and bias adjustment of the recording equipment used.

MICROPHONES

An excellent microphone is an equally excellent investment for 'musique concrete' in terms of quality of the reproduced sound. The best microphones are of the condenser type and range in price from $100 up. Excellent microphones of the dynamic type can be purchased for less than $100. The crystal type is the cheapest and least useable.

BASIC FUNCTIONS OF REEL TO REEL RECORDERS

The amount of control of tape signals an electronic music composer has is partially determined by how well he understands the normal operation and function of various parts of the tape recorder.

Transport Mechanism - When recording or playing tape, the tape is pulled past the heads by a rotating capstan. The tape is held against the capstan by a rubber pinch roller. The spindles that hold the reels are not designed to pull the tape except in FAST FORWARD or REWIND functions; they simply maintain the proper amount of tension on the tape during RECORD or PLAY for proper winding onto the take-up reel. The instant stop or pause control makes it possible to stop the tape without taking the recorder out of the RECORD or PLAY function.

Tape lifters keep the tape away from the heads during FAST FORWARD and REWIND to prevent excessive wear of the heads.

Figure 1 shows the basic parts essential to all tape recorders. These parts are shown in their relative position to each other. The design of individual recorders may vary from these diagrams but these basic parts and functions will still be represented on all recorders.

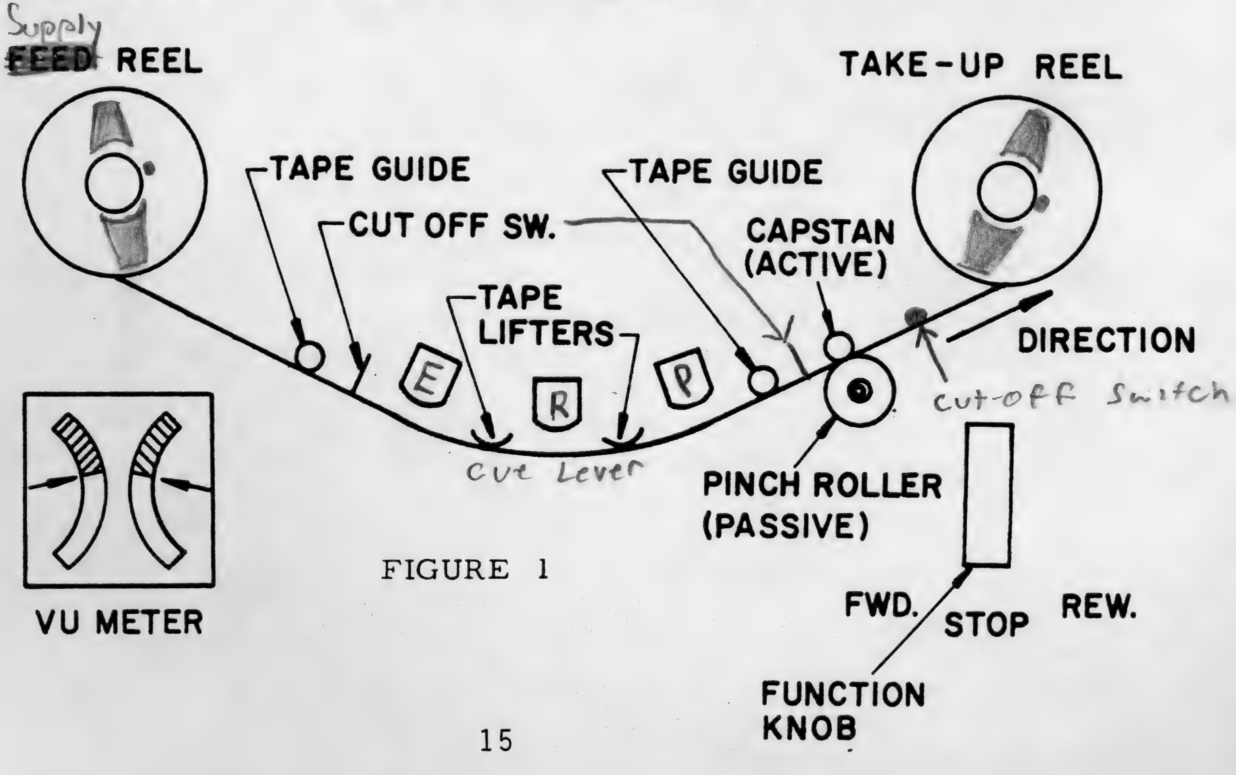
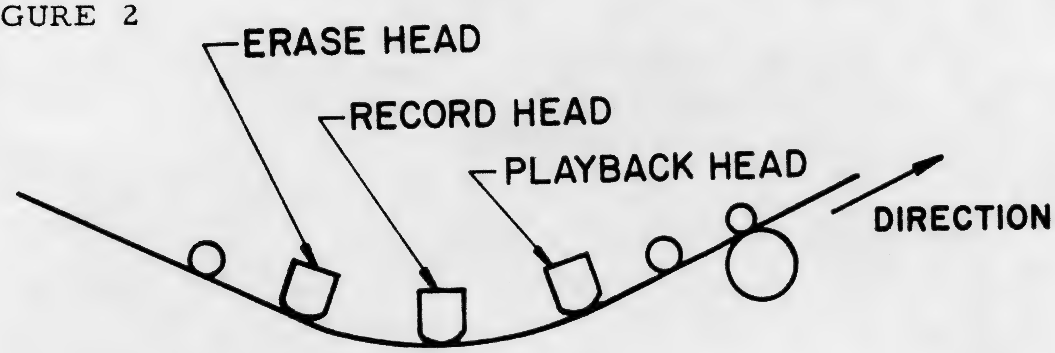

Supply
~~FEED~~ REEL
TAKE-UP REEL
TAPE GUIDE
CUT OFF SW.
TAPE GUIDE
CAPSTAN (ACTIVE)
TAPE LIFTERS
E
R
P
DIRECTION
cut-off Switch
Cut Lever
PINCH ROLLER (PASSIVE)
VU METER
FWD.
STOP
REW.
FUNCTION KNOB

FIGURE 1

Tape Heads - There are three functions that the tape heads serve, erasing, recording and playing magnetic tape. The erase head is always a separate head and the tape always comes in contact with it before reaching the record or playback heads. (See Figure 2.)

FIGURE 2



On many recorders, the record/play function is combined into one head. This is not as desireable as having a separate head for each function.

When there are separate heads for the record and playback functions, the tape passes the record head before it passes the playback head. It is then possible to monitor the sound on the tape immediately after it has been recorded. It is also possible to get an echo effect because of the distance between the two heads. (See Feedback -- Delayed Feedback.)

V. U. Meters - V. U. meters generally have a black ("safe") area and a red ("distortion") area. The best recording level as shown by most meters is when the needle stays near where the black and red areas meet with occasional peaks into the red and dips into the black.

Inputs and Outputs - Tape recorders for electronic music use must have microphone inputs (low level), auxiliary inputs (high level), and line outputs ('external speaker' or 'monitor'). The microphone inputs may only be used for microphones, however, any external electronic sound source such as another tape recorder, record player, radio, or electronic music synthesizer may be plugged directly into the auxiliary inputs. The V.U. meters are then used to monitor the incoming signals for proper recording balance.

Generally, when a microphone is plugged into the microphone input, a switch cuts out the auxiliary input so that it is not possible to use both simultaneously. To combine a microphone signal with another electronic signal it is necessary to use a mixer (see Mixing).

RECORDING FORMATS

When working with tape, it is important to understand the recording format of the recorder being used. The three formats considered here are widely used but there are several more that are available.

Half-track Monaural - One signal (one channel of sound) is imprinted on approximately one half (one track) of the tape leaving the other track blank. When the reels are exchanged and turned over the other track of the tape is then recorded but in the opposite direction (See Figure 3a).

Half-track Stereo - Each of two channels of sound is imprinted on a track that is approximately half the width of the tape so that the entire tape is "used" in one direction. (See Figure 3b).

Quarter-track Stereo - Each of two channels of sound is imprinted approximately one fourth the width of the tape but alternate tracks are used for channels going in the same direction. These channels are "sandwiched" with channels recorded in the opposite direction (when the reels are exchanged and turned over). (See Figure 3c) .

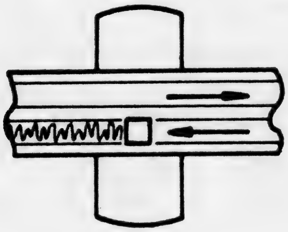


FIG. 3a

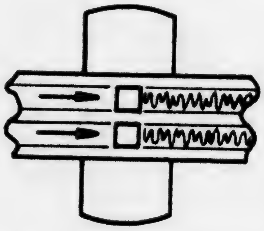


FIG. 3b

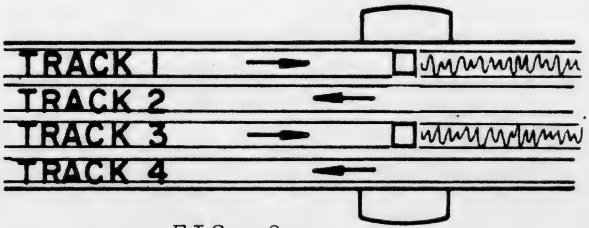
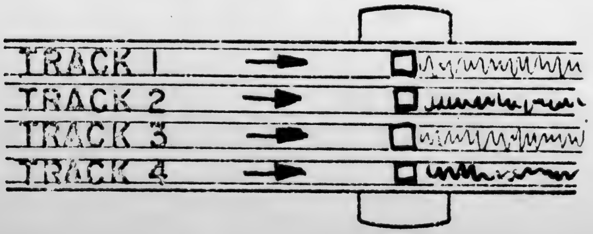


FIG. 3c

FIG. 3d



TECHNIQUES FOR TAPE CONTROL

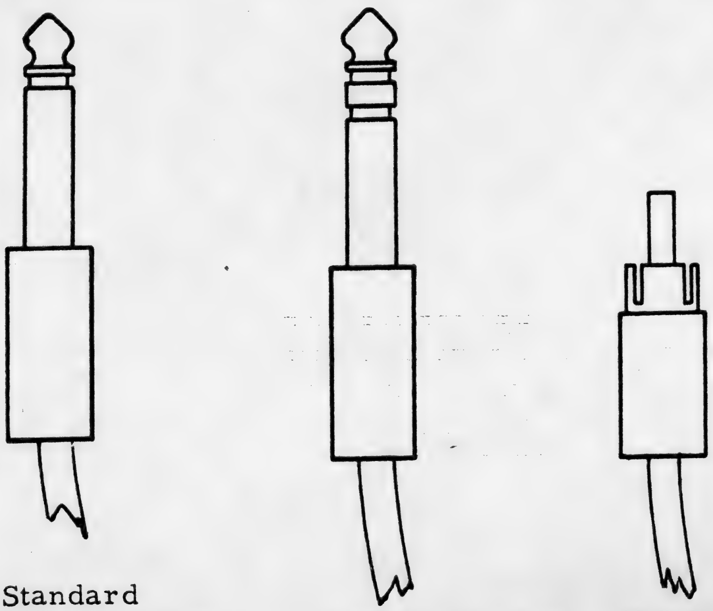
Microphone Recording - When making any recording using microphones, several factors must be kept in mind. Adjustments made on any of the following will change the nature of the recording:

1. distance between the microphone and the sound source.
2. size and acoustical properties of the recording environment.
3. type of microphone.
4. recording volume level.
5. speed of the tape.

It is helpful to experiment with these to find the right combination for the desired sound quality.

Direct-Wire Recording - A tape can be made directly from any electronic sound source such as a radio, phonograph, another tape recorder, an electronic music synthesizer, (ElectroComp, Moog, etc.), electronic organ, or electronic piano. The sound source must have an external output jack ('external speaker' or 'monitor'). One end of a patch cord must be plugged into that output jack and the other end plugged into the auxiliary input of the receiving tape recorder (not the microphone input). The plugs on the ends of the patch cord must match the output and input jacks on the equipment used. The cord must be long enough to go from one piece of equipment to the other. It is helpful to have a collection of patch cords of different lengths which have different combinations of plugs commonly used. There are also adapters which can convert one type of plug to another. (See Figure 4).

Fig. 4 Plug types



Standard "phone" plug

stereo "phone" plug

~~"RCA" plug~~ "phono"

Mixing - Sound mixing (or more correctly, signal mixing) is perhaps the most important technique is electronic music composition. It is also a basic operation in all radio, television, and recording studios. Mixing equipment ranges from simple inexpensive units to complex consoles.

A basic problem in mixing is retaining the quality of the original signals in the mixture. A simple "Y" adapter, for example, is not adequate for mixing the outputs from two signal sources because there is a significant loss of quality that occurs. An amplifier-mixer helps retain signal quality and can amplity signals that may be somewhat weak. (Figures 7 and 8 show some suggested uses of mixers.)

Feedback -- Delayed Feedback - Immediate feedback of a signal from a speaker into a microphone results in the usually undesirable "squeal" or "howl" so often heard in poor amplifying systems in auditoriums. The same effect may be obtained on some recorders when a microphone is plugged into the microphone input, the "source" and/or "speaker" switches are on, and the "record" buttons are depressed. Some composers have made creative use of this effect but it is difficult to control.

Three head recorder design makes possible a useable delayed feedback also called "echo reverberation". The "record" head is approximately one inch away from the "playback" head and the tape passes the "record" head before passing the "playback" head (See Figure 2), therefore it is possible to "monitor" or listen to the recorded signal immediately after it is recorded. The lapse of time between recording and listening is determined by the exact distance between the heads and the speed the tape is moving. If the signal from the playback head is fed through speakers (when recording with microphone; see Figure 9) this delayed re-playing is again recorded through the microphone. This process repeats itself over and over again giving an echo-like effect. The amount and quality of the echo is determined by a number of variables:

1. proximity of microphones to the speakers
2. volume levels (recording and playback)
3. acoustical properties of the recording environment
4. individual characteristics and quality of all equipment involved -- microphones, recorders, tape, amplifiers, and speakers.

A more controlled echo reverberation may be obtained by feeding the delayed signal by direct wire into a mixer with the initial signals.

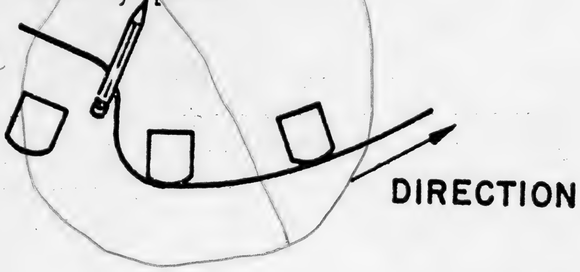
Tape Loop - A tape loop (see Splicing), a circle of tape that repeats a sound over and over, can be an effective technique for electronic composition. When several loops are used, the same number of tape recorders are needed as there are loops, plus another recorder to record the results. The resulting tape can then be combined with even more loops or with other recorded or electronic sounds for a mixture of sounds (See Mixing).

Sound with sound -- Sound on sound - When several tape loops are playing simultaneously the result is sound with sound; each sound is independent of the others. After the sounds on the loops are mixed and recorded together onto one tape, the result is sound on sound; the sounds are now intermingled in the same tape signal and cannot be separated from each other.

On a stereo recorder it is usually possible to record each of the channels separately (giving sound with sound). However, on most recorders it is not possible to accurately synchronize the second recording with the first. When recording on the second channel of a two head recorder, the first channel cannot be played. On three head recorders there is a distance of approximately one inch between the record and playback heads which means that on playback, there will be a time delay in the second recording. Special recorders with four or more channels which are designed for mixing, are employed in professional studios for accurate synchronization of several channels.

Erase-Head Bypass - Erase head bypass is a method of getting sound-on-sound which is difficult to control and which distorts the original signal but is quite easy to accomplish on many recorders. When threading a recorded tape for additional sounds, place the tape behind the erase head (using a pencil as a tape guide) and thus recording. (See Figure 6) When using this method it is not possible to synchronize the two signals (See Sound-with-Sound --- Sound-on-Sound).

Fig. 6 Erase head by-pass



This is impossible to do!

Introduction to Open Reel Tape Decks

Open Reel

Many articles have been written concerning the relative merits of open reel decks vs cassettes decks. Some of these articles have even selected one or the other as being better. Our position, at TEAC, is that both types are excellent, can give good service and provide many months and even years of recording and listening pleasure. A large number of audiophiles own both an open reel deck and a cassette deck. Cassette decks have many advantages and features that continue to attract customers (especially convenience and price). Open reel decks also have capabilities and features that appeal to many serious audiophiles. Here are some of them. Features such as separate Record/Playback heads, Editing and cueing controls, mic-line mixing, monitoring functions, provide versatility for many creative recording situations. The modern audiophile doesn't seem to be content to just record performances as they are. He or she wants to create, to experiment, to modify. They want to put something of themselves into their recordings.

The pro or semi-pro recordist will find the high end performance and versatility a distinct advantage. Few, if any, records are made today directly from a single live performance. A singer's voice is recorded at one time, instruments are added or changed, a chorus may be added and often other special effects are mixed in. The final recording may be completely unrecognizable by the artist who sang the original song.

The higher speeds of the open reel decks make possible higher quality recordings which challenge the limits of one's entire stereo system.

The quality, styling and price of open reel decks make them prestige items. A well designed open reel deck seems to blend in with the most expensive furniture decor and even enhances the overall atmosphere of successful living.

There are various head types and configurations. This section is intended to give you a basic idea of how some of the systems operate. Please consult your owner's manual for complete details of the features and capabilities of your deck.

Earlier models of tape recorders used a combined Record/Play head. (Diagram A). With such a head, you cannot record and reproduce at the same time. Another disadvantage of the combined head was in the design of the width of the head gap. Modern head technology generally dictates that the gap width should be different between the record and playback functions for optimum output and frequency response.

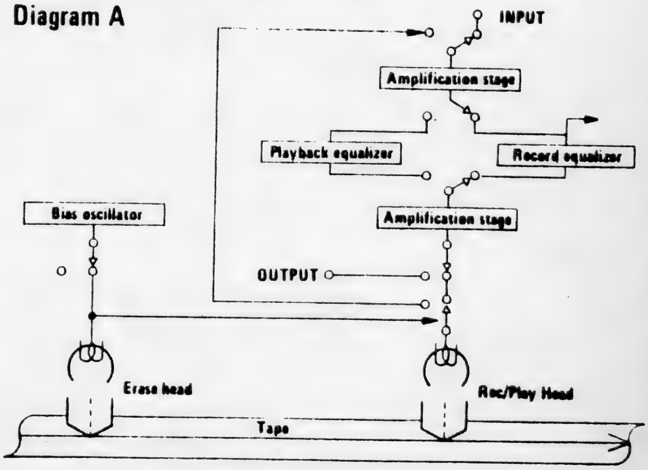
When there are severe space and cost limitations, combined record/play heads are still used today, and even though these heads are well designed and highly efficient they still represent a compromise of optimum head design. Open reel decks which normally have no head space limitations and usually command a higher price due to their special capabilities, normally have separate Record and Play heads. (Diagram B). The separate heads allow monitoring of the tape during recording. This system has distinct advantages. You can insure that your tape is actually being recorded properly as you record. The playback signal can also be connected to the record head for special effects, such as sound-on-sound, echo and sound-with-sound. (These techniques are explained on pp. 9, 10.)

With separate record and playback heads there will be a time delay between the recorded signal and the reproduced signal. The delay depends on two factors; the physical distance between the two heads and the tape speed. For instance, if the record head and playback heads are 1-7/8" apart and the tape speed is 3-3/4 ips, the delay is about 1/2 second. With the tape speed increased to 7-1/2 ips; the delay is 1/4 second. At 15 ips the delay is about 1/8 second. See diagram B.

For some recording situations, even this fraction of a second is not acceptable. If a musician or audiophile wanted to add a new instrument or voice to a song already recorded and wanted to listen to the recorded song for timing and synchronization, this delay would present a problem.

Combined Rec/Play heads

Diagram A



Separate Record and Play heads

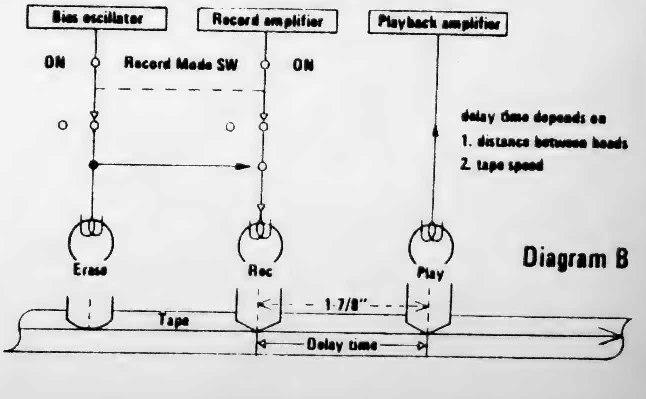


Diagram B

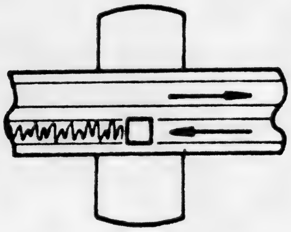


FIG. 3a

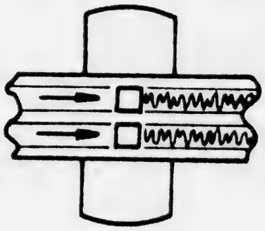


FIG. 3b

Ho - Heads out - ready to play
To - Tails Out - right to left

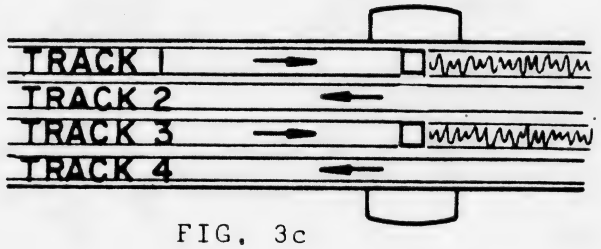
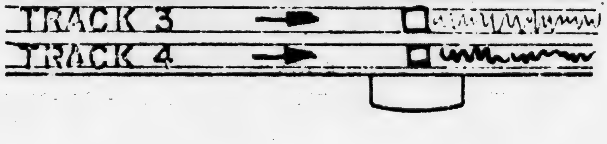

TRACK 1
TRACK 2
TRACK 3
TRACK 4

FIG. 3c

FIG. 3d


TRACK 1
TRACK 2
TRACK 3
TRACK 4

Tape Tracks and Channels of The Open Reel Tape Decks

1. **Full track recording**: The magnetic flux pattern produced by the head covers almost the whole surface of the tape. The entire tape is recorded in one direction only.

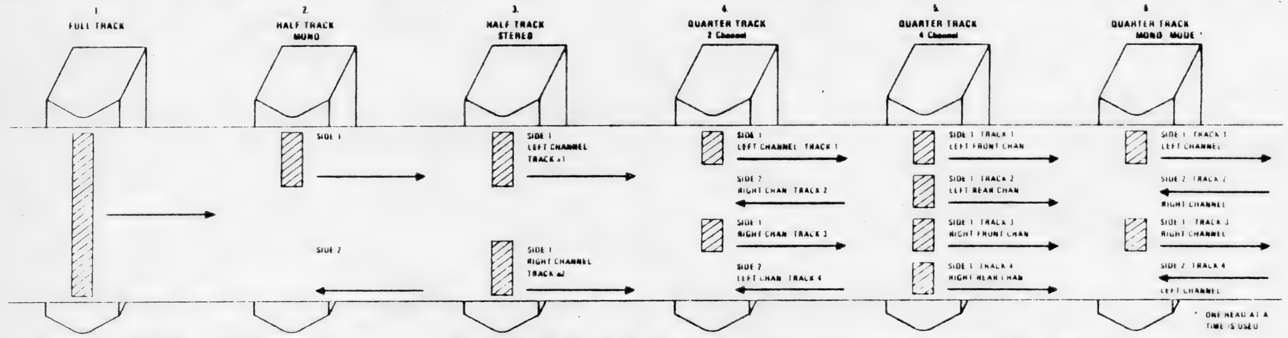
2. **Half track monophonic**: The flux pattern generated by the head covers less than half of the tape surface and the recording head is off-set to one edge of the tape. A monophonic signal is recorded on one half of the tape and then the reels are inter-changed and the other half of the tape is recorded. The same half track head is used for both passes. The tracks are, of course, recorded in opposite directions on the tape.

3. **Half track stereo**: Two recording sections (heads) are used to record two tracks simultaneously on the tape. Both channels are recorded in the same direction on one pass through the tape.

4. **Quarter track, 2-channel stereo**: 2 record heads are used to record all 4 tracks on the tape. On the first pass through the tape, track 1 and 3 are recorded simultaneously. At the end of the first pass, the reels are inter-changed and tracks 2 and 4 are recorded using the same two heads that recorded tracks 1 and 3. The actual program on the tape for tracks 1 and 3, and 2 and 4 is recorded in opposite directions but since the reels are inter-changed between passes, the tape is recorded and played in the forward direction for both passes of the tape.

5. **Quarter track, 4-track/4-channel (Quadriphonic)**: The head assembly consists of 4 separate heads and all 4 tracks can be recorded at the same time on a single pass through the tape.

6. **Quarter track, single channel (Monophonic)**: The 4 tracks on the tape are recorded one track at a time. At the end of each pass through the tape the reels are inter-changed and the next track is recorded. The order in which the tracks are recorded is 1, 4, 3 and 2. Four track recording gives maximum playback time however, the benefits of stereo reproduction are lost.


1.
FULL TRACK
2.
HALF TRACK
MONO
SIDE 1
SIDE 2
3.
HALF TRACK
STEREO
SIDE 1
LEFT CHANNEL
TRACK #1
SIDE 1
RIGHT CHANNEL
TRACK #2
4.
QUARTER TRACK
2 Channel
SIDE 1
LEFT CHANNEL TRACK 1
SIDE 2
RIGHT CHAN TRACK 2
SIDE 1
RIGHT CHAN TRACK 3
SIDE 2
LEFT CHAN TRACK 4
5.
QUARTER TRACK
4 Channel
SIDE 1 TRACK 1
LEFT FRONT CHAN
SIDE 1 TRACK 2
LEFT REAR CHAN
SIDE 1 TRACK 3
RIGHT FRONT CHAN
SIDE 1 TRACK 4
RIGHT REAR CHAN
6
QUARTER TRACK
MONO MODE *
SIDE 1 TRACK 1
LEFT CHANNEL
SIDE 2 TRACK 2
RIGHT CHANNEL
SIDE 1 TRACK 3
RIGHT CHANNEL
SIDE 2 TRACK 4
LEFT CHANNEL
* ONE HEAD AT A TIME IS USED
DEPICTS RELATIVE SIZE AND LOCATION OF RECORD HEAD
INDICATE DIRECTION OF TAPE MOVEMENT

STANDARD OPEN REEL HEAD CONFIGURATIONS SHOWING HEAD LOCATIONS.
RELATIVE TRACK LOCATIONS ON TAPE AND RECORDING PROCEDURES AND FORMATS.

DIAGRAM A.

Playback compatibility

Diagram A shows the relative track locations and dimensions on a standard prerecorded ¼" open reel tape. The playback heads closely correspond to the record heads depicted in the diagram. Some decks in fact use the same record head for playback also. A brief study of the track locations and recording sequence for the various common tape formats will lead to many valid conclusions concerning compatibility between various tapes and tape decks. Some of these conclusions are stated briefly below.

1) A half track mono deck can playback a pre-recorded full track tape.

2) A half track stereo deck can play either a full track or a half track tape but the signal from a half track mono tape on side 2 will be played back in the opposite direction. However, the right channel output can be turned down and the left channel only used for playback of both sides of the tape. When playing a full track tape the left and right channel will reproduce the same sounds.

3) A four track stereo tape deck can playback both 4 track and 2 track tapes and from the point of compatibility has the widest possible range of utilization. When playing a 2 track stereo tape on a 4 track recorder, track #1 will be completely covered by the head. Track #2 will be slightly off alignment but stereo can still be enjoyed by compensating for the slight loss of track #2 volume with the volume or balance controls of the amplifier. On the other hand a four track tape cannot be played back on a two track recorder as both tracks #1 and #2, and #3 and #4 will be reproduced together resulting in mixed unintelligible sound.

There are of course other possibilities for playback compatibility that the inventive audiophile or home recordist can discover by consulting this diagram and other sources. The procedures for recording in each of the various formats will be covered in the Owner's Manual supplied with each TEAC deck. This section is intended to give the interested recordist a complete overview of standard recording tape formats.

Almost all tape decks are designed and constructed to record and playback only one of the standard formats. A few 4-channel decks have a selectible 2-track playback head for compatibility with pre-recorded 2-track tapes. Full track and half track monophonic decks for home use are rarely, if ever, available today. Full track professional decks may be purchased however.

Bias and Equalization-General Theory

Bias

In order to get the magnetic particles on a tape to respond properly to the changing signal supplied to the record head, a pre-conditioning bias is needed. Most home recorders today use an alternating current (AC) bias at a frequency of 50 to 150 kHz. This bias raises the magnetic level of the oxide particles so that even small changes in the signal from the record head will cause relatively similar changes in the magnetic level of the particles on the tape. Without this bias pre-conditioning, the oxide particles do not respond properly to the signal from the record head. This high frequency bias signal is applied to the tape together with the desired audio signal by the record head. Since the bias signal frequency is much higher than the audio frequency range, there is little chance that the bias signal will interfere with the sound reproduction.

The amount of bias (bias level) affects the signal-to-noise ratio, distortion and the frequency response of the tape and hence of the deck itself. Too little bias will allow more distortion than is necessary. Bias also affects the output level of the tape. Normally, as bias is increased the signal level off the tape increases, up to a maximum output level which depends on the type and quality of the tape. Increasing the bias level beyond this point causes the output level (and consequently, the S/N ratio) to decrease. The "optimum" level of bias is usually a compromise between the best results in S/N ratio, distortion and high frequency response, and usually differs with different types and brands of tape. For this reason, all TEAC tape decks offer the user a switch selection for different bias levels or a bias adjustment. One or the other of these is absolutely necessary if the recordist expects to use more than one type of tape. If everyone used the same type and brand of tape, the tape deck manufacturers could all set their bias circuits for a specific type of tape and everything would be fine. But, there are many good brands and types of tapes available and many recordists use more than one type of tape. Experience and experimentation will help you decide which tape to use and what bias level is most appropriate for specific situations.

TEAC offers charts and/or instructions on how to set the bias level for various brands of tape. These instructions should be followed until the recordist developes sufficient knowledge (and has the proper measuring equipment) to make reliable tape evaluations.

Equalization

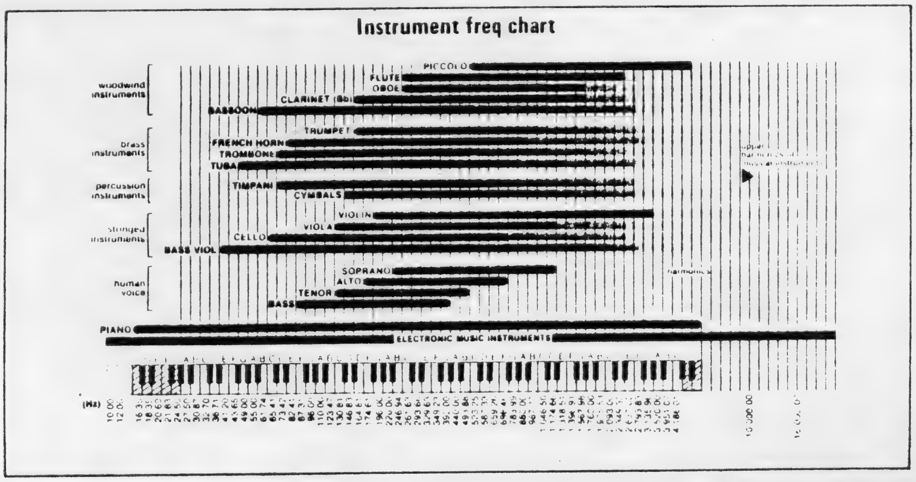
The EQ (equalization) selection must also match the type of tape formulation being used. If for instance, a deck was factory adjusted for standard tapes and the recordist decided to use low noise/high output tapes with their accompanying high frequency emphasis, the high frequencies would sound too bright.

The equalization switch can be used to reduce this high frequency over-emphasis and restore the output signal to its original fidelity. Conversely, if the deck is factory adjusted for low noise/high output tapes and the recordist decided to use standard tapes, the high frequencies will be much lower and an equalization setting that emphasizes high frequencies should be selected to compensate for these low levels. TEAC tells in our instruction manual what equalization level should be selected for various types of tape. Together with the bias setting, the suggestions should be closely adhered to until the audiophile developes the experience and knowledge to decide for himself.

Frequency Response

Frequency response is one of many parameters or specifications that manufacturers consider in the design of their open reel tape decks. But it is possible to over-emphasize this one parameter at the expense of others, such as signal to-noise ratio. In general, it's best to consider a well designed tape deck as a series of compromises that are made to give the best overall operation and performance.

The following musical sound frequency chart will help you understand the basic requirements of frequency response versus actual recordable frequencies.


Instrument freq chart

The Tape-Record Time vs Length

The Tape

The length of a full reel of recording tape as well as the recording time, is determined by the reel diameter and the thickness of the base material.

The use of 1 or 1/2 mil base tape is recommended for 4 track high fidelity recording. Polyester base tape is preferred for use in humid or extremely dry areas. Three recording speeds are commonly used, 3-3/4, 7-1/2 and 15 inches per second (ips). 15 ips is generally used for production of master tapes and for professional and semiprofessional use. 7-1/2 ips is commonly used for home high fidelity recording. Generally speaking, the higher the recording speed, the better fidelity (especially at the very high audio frequencies). However, due to the extremely high quality of the TEAC tape decks, recordings of excellent quality can be made at the lower speeds. This provides maximum tape economy and extended playing time.

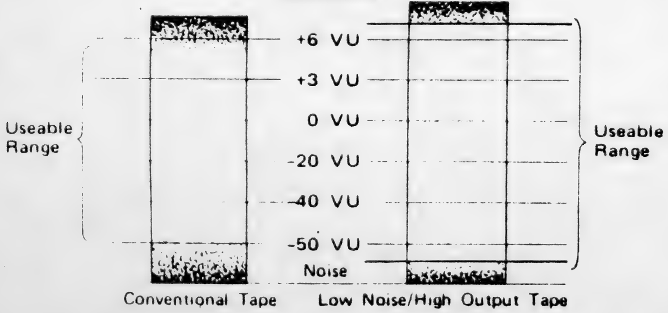
The recording time indicated in the charts below is for one single pass of the tape, therefore the total recording time will be either two or four times that indicated, depending upon the method of recording (2 track stereo or monophonic).

7″ reel			
Base	Tape length	Recording time	
		7-1/2 ips	3-3/4 ips
1-1/2 mil	1200 ft.	30 min.	60 min.
1 mil	1800 ft.	45 min.	90 min.
1/2 mil	2400 ft.	60 min.	120 min.

10-1/2″ reel				
Base	Tape length	Recording time		
		15 ips	7-1/2 ips	3-3/4 ips
1-1/2 mil	2400 ft.	30 min.	60 min.	120 min.
1 mil	3600 ft.	45 min.	90 min.	180 min.
1/2 mil	4800 ft.	60 min.	120 min.	240 min.

Level Setting

Correct level setting of the MIC and LINE Input Controls will assure full frequency response, maximum dynamic range, minimum amount of tape noise and the least possible distortion in your recorded tape. This is based upon the nature of magnetic recording tape which has a useable recording range as shown in the chart below.



When the input level (an audio signal of a specified voltage) is very low or weak, it must compete with the hiss and noise always present at the same low level on the tape. Stronger input levels, are recorded above this tape noise and tend to cover or "mask" it so you hear only the desired sound during playback. If the input level is too high, it enters the region shown at the top of the chart, which represents the limits of the tape. This limit says that no matter how much stronger you record, the tape cannot accept and return the same strength of signal. The result is known as "saturation distortion", and is heard as a garbled or harsh sound. The dynamic range available is found between this distortion at the high end and the noise at the low end. As the chart also shows, there is a difference between recording tape. The tape on the left is representative of conventional or normal recording tape. To the right is the improved kind of low noise/high output tape.

Input Level Controls (MIC and LINE) are used to match the strength of the input signal to the requirements of the tape. If the input signal is a little too strong these controls must be adjusted to reduce it to prevent distortion. If the signal is a little too weak, the controls must be set to increase the preamplification for raising the signal above the tape's noise level. Of these two limits, the distortion caused by high level inputs is used as a reference for setting the controls. Generally speaking, the shaded area at the upper (right side) of the VU meters' scale indicates that distortion levels are being approached. This area begins at 0 VU.

As the ideal is to record the program without distortion of the loud parts or losing the purity on the quieter parts, the recording level must consider both limits.

Choice of Tape

Most magnetic tape available commercially today is clearly marked with its specifications, such as thickness, type of base material, tape length (or reel diameter) and other characteristics.

Since TEAC open reel decks are factory adjusted for use with low-noise types of tapes as standard reference, we recommend that you use the tape selection table printed in the Owner's Manual for selecting the tape to be used.

Owner's Care

"A Clear Head is a happy Head"

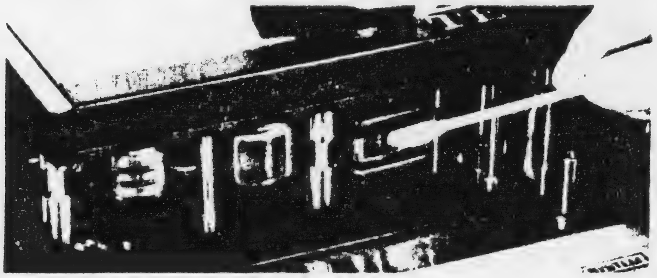
Cleaning and Degaussing

The single most important point in tape deck maintenance is frequent and proper cleaning of the heads. The heads should always be cleaned before making important recordings and at least once for every 8 hours of use (record or playback). Dirty heads will cause a reduction in high frequency response, irregular head wear, drop-outs and in extreme cases may cause the deck not to record at all. The small amount of time and effort required will be more than compensated for by the higher quality of recording and reproduction available if these procedures are followed.

Commonly used cleaning fluids are chlorothane, isopropyl alcohol and TEAC Head Cleaner (Fluid "A" in the TZ-261 kit). Chlorothane is non-flammable and has excellent cleaning properties. Alcohol is harmless but is combustible and its cleaning properties are lower. TEAC Head Cleaning Fluid is non-toxic, non-combustible and has excellent cleaning properties and its use is recommended.

Using a stiff cotton swab or a piece of gauze dipped in cleaning fluid, rub the entire head surface, being cautious not to scratch it. Repeat the process on each head until all discoloration and tape oxides are removed. Clean all metal parts over which the tape passes, such as capstan shaft, tape guides, tape lifters, etc.

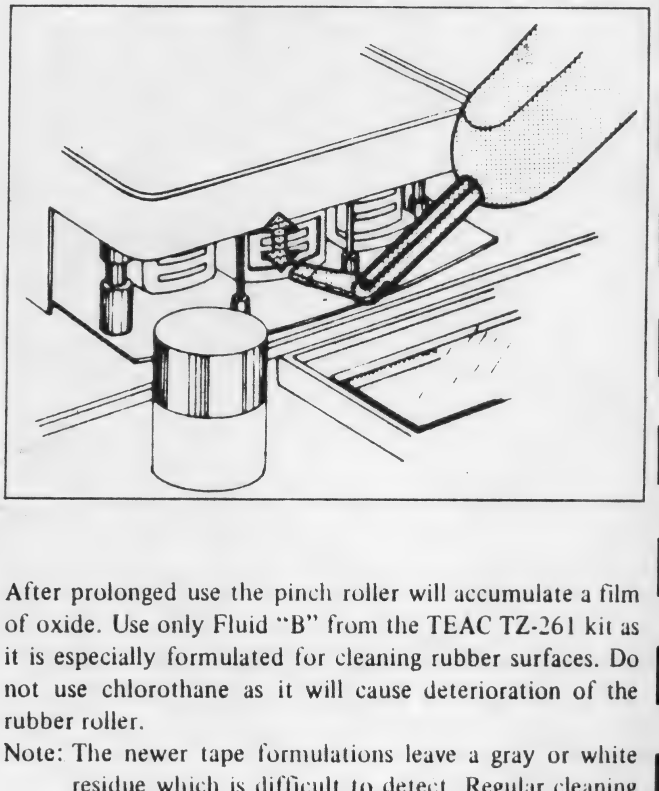
The cotton swabs should have a rigid shaft, a satisfactory job cannot be accomplished with the slender flexible types often seen.



TEAC TZ-261
CLEANER

During long periods of use, the heads may become slightly magnetized. As a result, high frequency response will decrease, noise will develop, or in extreme cases, the high frequencies will drop-out or noise will be introduced into your valued pre-recorded tapes. To keep your deck operating with its original fidelity the heads should thus be degaussed at least once for every 50 hours of use, with i.e., TEAC model E-1 Head Demagnetizer. Places specified for degaussing include each head, capstan shaft and guide post. Before proceeding with the following steps move all the pre-recorded tapes sufficiently away from the degaussing area.

1. Turn OFF power to the deck.
2. Slide the switch of E-1 ON, bring the tip close to the head and slowly move it up and down four or five times.
3. Slowly draw it away from the head.
4. After finishing all points, turn OFF power to the demagnetizer only after it has been drawn at least 12 inches (30 cm) away from the heads.



After prolonged use the pinch roller will accumulate a film of oxide. Use only Fluid "B" from the TEAC TZ-261 kit as it is especially formulated for cleaning rubber surfaces. Do not use chlorothane as it will cause deterioration of the rubber roller.

Note: The newer tape formulations leave a gray or white residue which is difficult to detect. Regular cleaning schedules should be established rather than relying on observation.

Care of the wooden cabinet

Ordinary furniture cleaner and polish can be used to maintain the attractive finish.

Cleaning the Faceplate.

A soft cloth and mild cleaning fluids (non-abrasive) can be used to restore the luster of the faceplate. An oil-damped cloth will also give good results, but take care not to get oil on the tape path components such as the pinch roller, capstan, etc.

TAPE DECK #.1

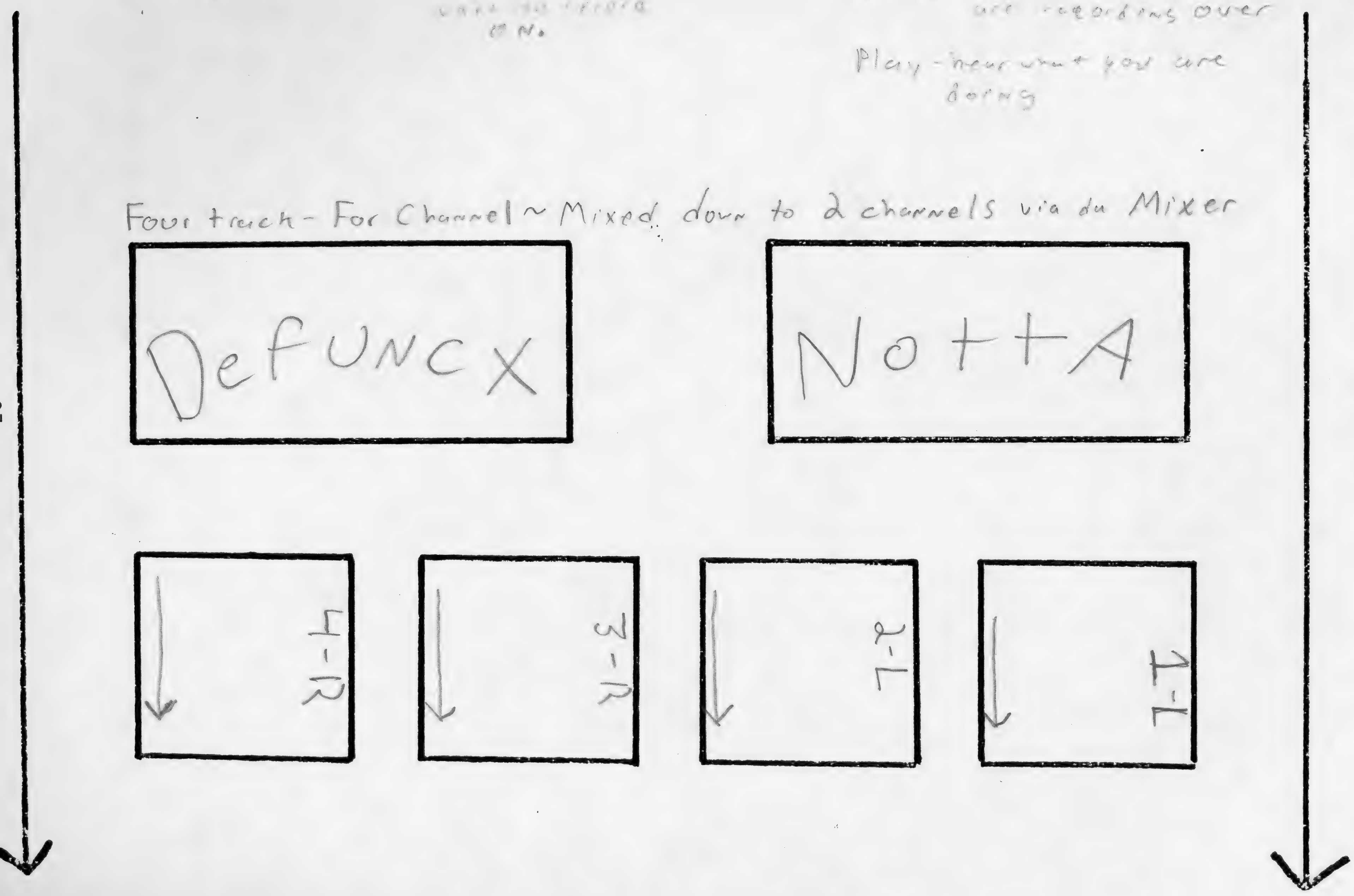
☐ - erase
☐ - record
☐ Playback

Function Select
1 2 3 4
Press a button to
which track you
want to record
on.

Output Select
Source Sync Play
Source - hear what you
are recording over

Play - hear what you are
doing

Four track - For Channel ~ Mixed down to 2 channels via the Mixer



TAPE DECK #.2

Eq & Bias - set to 1 (up) ~ this deals with the tape type

Line - from taped directly tape deck 1 to 2 or the synthesizer

Mic - determines input level ~ Caution: never have an input & output up at the same time

Source ~ (up/up = Source/Tape) - Up to play, in to record

4track/2track switch (Changed the heads) ~ keep on 2track

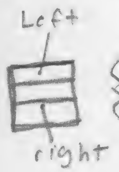
Left & Right Track switches must be up to record

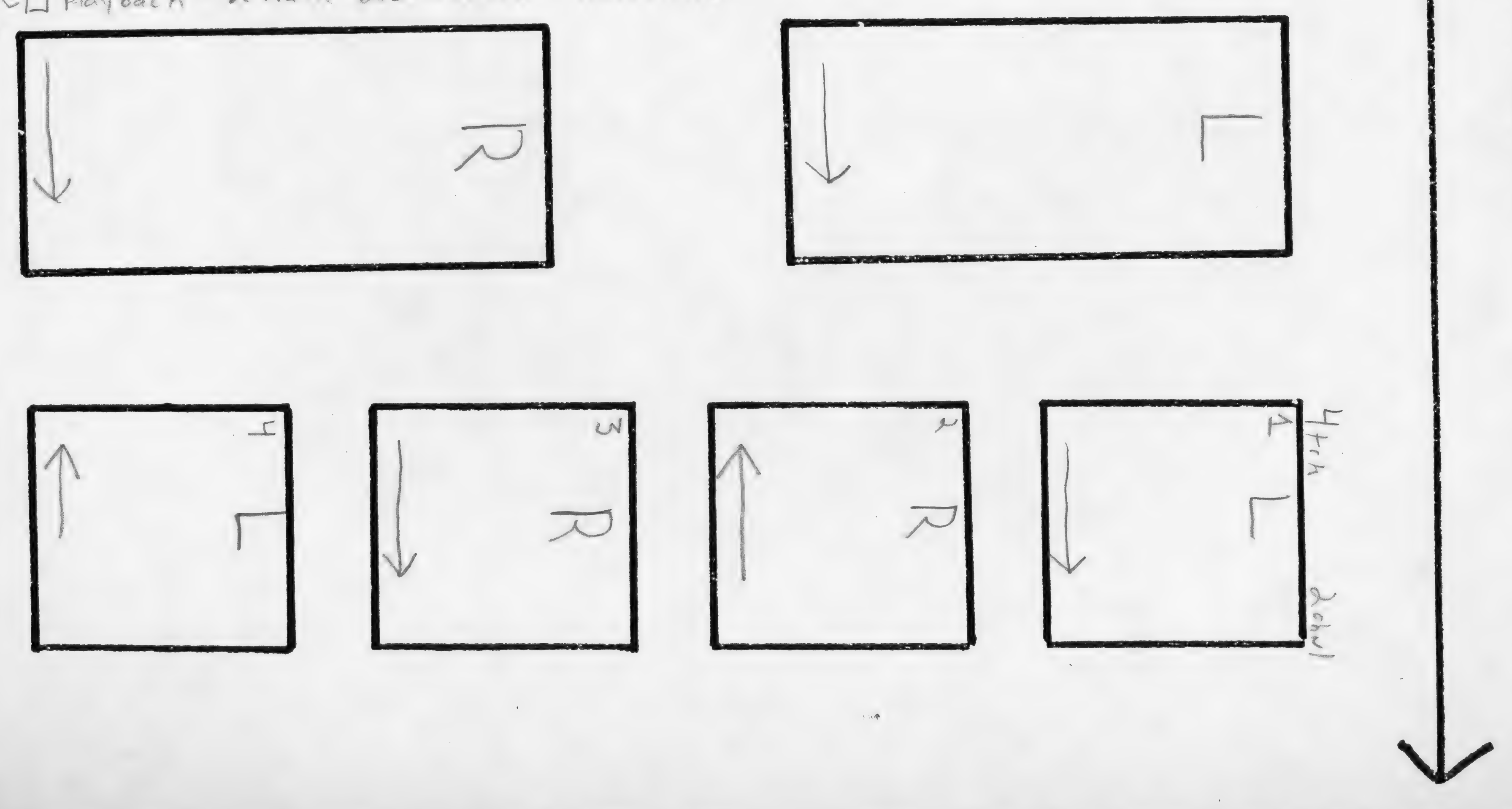
☐ erase

☐ record

☐ Playback - 4 track 2channels

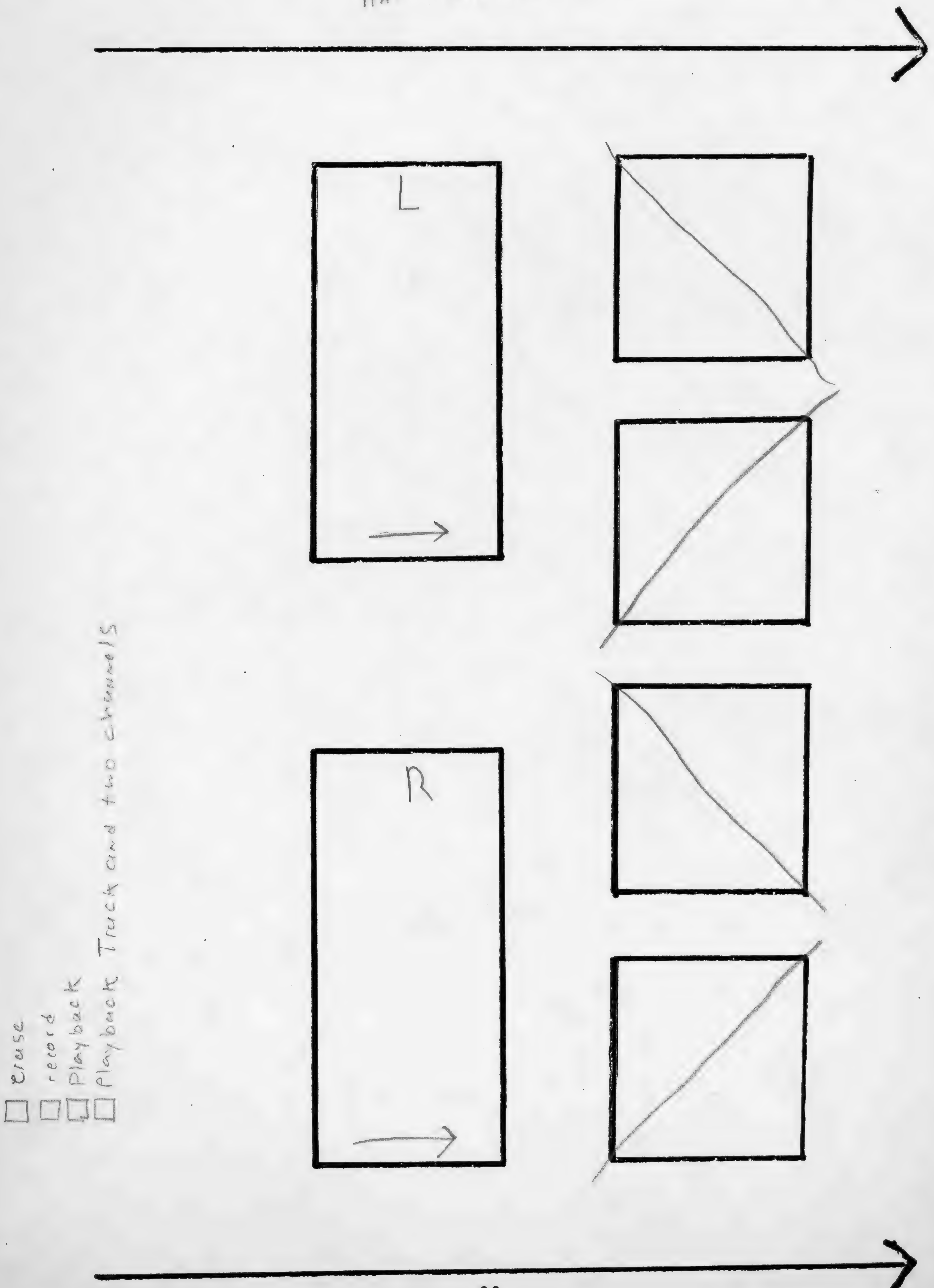
☐ Playback - 2 track 2channels = halftrack





TAPE DECK # 3

Half track


L
R
☐ erase
☐ record
☐ Playback
☐ Playback Track and two channels

CASSETTE TAPE DECK OPERATION

TAPE TECHNIQUES

SPEED CHANGES

going from low to high or vise-versa, with the exception of TD1, which has variable speed.

HAND MANIPULATION

moving of the reels by hand in order to edit.

SOUND-ON-SOUND

must disable the erase head to achieve this.

Not Effective.

TAPE LOOPS

Connecting a tape at both ends so it plays over & over again

TD2
< 18"

SOUND-WITH-SOUND

Normal, common recording.

FEEDBACK

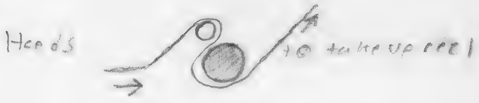
An input & output up at the same time on the same chanel

DUBBING

A copy of a tape.

Master
Dub
1st Gen. 2nd Gen.

BACKWARD SOUND



TAPE REVERSAL

Playing on wrong side of tape. Caution: watch tape or slip happens!
Channels are reversed.

PARTICLE REMOVAL

taking off ferric oxide from tape

Not Used

CHANNEL REVERSAL

The channels are reversed.

PANNING

fading from L to R or vise-versa

MIKE ECHO

1. record on a track
2. hold mike to speaker
3. Record it on opposite channel

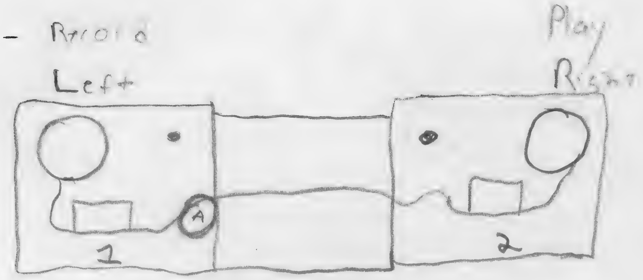
LINE ECHO

re-recording on a different track by changing the bus assignments on the mixer,

TAPE DELAY

Caution!

Use clean Tape



A - hub for cutoff level

record on Left of Tape deck 1, play on Right of deck 2, and records [illegible] On Tape deck One, Right.

SPLICING

~~SIMUL~~-SYNC

TD 2 turns the record head into a playback head: Cannot get an echo if used!

FLANGING 1 & 3

Use 2 tapes with exactly the same thing.

Record on TD 2.

Must be started exactly.

ADDITIONAL TAPE RECORDING FORMATS

PROCESS FOR MAKING A MULTITRACK TAPE (SIX TRACKS)

SPLICING BLOCK

45° is most UnCommon - loses part of tape

90° is most Used* to connect leader to reg. tape

The { 85° is used
Same { 65 is also used

45°- Blank to Blank

90°- leader tape

85°-65°- Sounds

EDITall Tape Splicing and Editing System

I
The EDITall® Tape Splicing & Editing System

The EDITall System is the simplest and most complete system yet devised, not only for repairing broken tape, but also for cutting, splicing and editing tape. The complete simplicity of this system when it is thoroughly understood allows anyone—novice, amateur or professional—to splice and repair tape perfectly and permanently. It is therefore essential that these instructions be read completely and understood completely before your EDITall Block is mounted.

II
How the EDITall Block Works

The EDITall Block is designed to grip standard recording tape firmly while you are cutting and splicing the tape. The groove in the block is slightly curved and the sides of the groove have tiny protruding dovetails machined in them. When you press the tape into the groove, with the shinier side (base side) of the tape facing up, by running your finger over the tape the length of the block, the tape snaps into the groove and the tape edges are held under the tiny dovetails. The tape may then be slid in the groove, but it cannot move by itself. Never try to remove the tape by peeling it out of the groove; you would ruin the tape by doing so! The proper way to remove tape from the groove is to grasp it by both hands at the ends of the block, pull the tape taut and snap it up and out of the groove. Repeated tests conducted by a nationally famous tape manufacturer have proved that the EDITall Block, properly used, does not damage tape in any way.

III
How To Cut Tape

The EDITall Block is designed for cutting the tape with a single-edge razor blade, such as supplied with EDITall® Kits. Care must be taken that any cutting tool be sharp and be completely demagnetized. Therefore if a simple, inexpensive, sharp and easily replaceable cutting tool such as a razor is used, whenever it becomes dull or is accidentally magnetized it should be discarded and replaced.

Your EDITall Block has two cuts which guide the cutting blade. The diagonal cut is at an angle of 45 degrees to the horizontal and should be used in most cases so that there will not be any noisy clicks caused by the sudden change in recorded bias voltage at the splice. The 90° cut is used only when editing information, where the reproduction of voice or music is not required. This 90° cut should not be used normally, and should be disregarded unless you use it for splicing in a piece of switching foil or to add leader tape.

With the tape in the groove ready for cutting, hold the razor with its forward point in the cutting slot, and slice the tape by pulling the blade back toward you while holding it firmly down in the slot (Fig. 1). Make certain the razor blade is not magnetized. If it should be magnetized it will magnetize the tape; you will then hear a "click" when that part of the tape is played back.

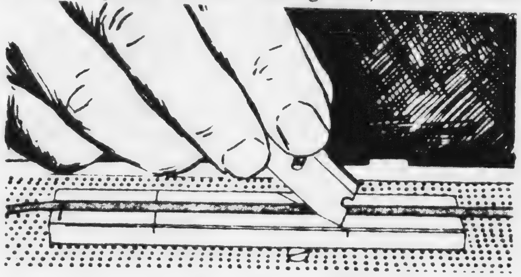


Fig. 1

IV
How to Splice Tape

After you have made the first cut, slide the tape along the groove of the EDITall Block until you reach the mark for the second cut and make this cut the same way and with the same cutting groove guide. Remove the section of the tape, cut out and butt the two remaining ends firmly together in the block, allowing the groove of the EDITall Block to hold the two ends of tape in place at the diagonal cutting slot; then splice as shown in sec. V.

For broken tape which you simply wish to repair, the same procedure is followed, except no cuts are necessary provided the ragged edges of the broken tape have not affected the width of the tape. The two ends of the tape falls (see Fig. 4), either by grease pencil or by making a tiny saw cut in the corner edge of the block. If you use a grease pencil for this purpose, make this mark permanent by covering it with a bit of transparent adhesive tape.

Once you have established this tape marking distance for your recorder on your EDITall you will always know exactly where to cut the tape without removing the head covers. Thereafter all you have to do when editing tape is to mark it at the marking point, align the tape thus marked with the right-hand mark you've made on your EDITall, and then cut the tape at the diagonal slot of your EDITall. This is the most accurate way to edit tape – considerably more accurate than by marking tape at the head gap every time you cut. In addition to gaining accuracy, you avoid marking the head gap with grease pencil marks, which reduces high frequency response, causes head wear and may misalign the head.

If there is no convenient place, like the stud in Figure 3, to mark tape on your machine, cement a little block of wood to the deck somewhere where it is convenient for marking tape and does not get in the way of normal tape travel. This should not touch the tape as it moves, but remain about 1/8 inch behind the tape. Mark the block also, so that your cut will be precise, not just approximate!

X

Tape Editing Practice

Now that you know how to mark, cut and splice tape, you are ready to learn how to edit the tape. The easiest way to learn is by beginning with ordinary speech. Record a few sentences from a newspaper or magazine on tape and then "edit" the printed sentences by running a pencil line through the words or phrases you want to eliminate. Then play what you have recorded before cutting the tape, noting carefully whether the words you want to edit can be cut out and still leave natural-sounding speech. It is one thing to edit on paper and quite another to edit recorded speech on tape. You will find that people speak with rhythm, with inflection and a characteristic pace. You have to become familiar with speech habits in order to become a good tape editor. Leave in the necessary spaces between words, longer spaces between sentences and phrases – and don't forget to leave space so that the speaker can breathe!

Mark the tape for editing at two points: just before the first sound of the part you want to eliminate, and just before the following part you want to leave in. Editing in this way will help to maintain the speaker's natural pace. After you have marked both points, cut the tape at the first point, moving the tape reels by hand, and pull out the tape you are eliminating up to the second mark. Place this part of the tape in the block and cut it. Then put the other loose end of tape in the block and splice the two ends together, as shown in Section V.

Very few editors can work accurately without turning the tape reels by hand. Practice doing this until you can reproduce a word recorded on the tape at normal speed. Then learn to recognize sounds when the tape is moved at less than normal speeds. The ability to distinguish one sound from another at low tape speed will come to you in time, but only after much practice. Learn first to tell the difference between various consonant sounds, like the sounds of t, d, k, and so forth. Then learn, by listening, all the other sounds of speech, until it becomes easy to recognize any speech sound at low speed. When that time comes you will be well on your way toward becoming an expert tape editor.

XI

EdiTall Booklet on Tape Editing

A more detailed approach to tape splicing and editing is available from all EDITall dealers or by contacting ELPA MARKETING INDUSTRIES, INC. directly. Send $1.00 to cover cost of handling and shipping of "Tape Editing" by Joel Tall, (available from either ELPA, New Hyde Park, N.Y. 11040 or Scottsdale, Ariz. 85253).

ELPA MARKETING INDUSTRIES, INC.
NEW HYDE PARK, NEW YORK 11040
SCOTTSDALE, ARIZONA 85260

tape, with the shinier side facing up, are simply inserted into the block, and are slid along in the block until the two ends butt together and the splice is then made as described in the following:

V
Use of "Editabs"

Editabs™ (Tape Splices) have been primarily designed for use with all EDITall Splicing Blocks for ¼" tape. The Editab is placed in the block in the manner illustrated after the recording tape has been cut and placed in position in the EDITall Block. Position the two diagonally cut ends of the recording tape, butting together tightly at the diagonal cutting groove of the block. Remove an Editab off the strip by the red end. The Editab is then slid on its edge across the groove, positioned by means of the position-locating tab "A" as illustrated, then snapped down into the groove.

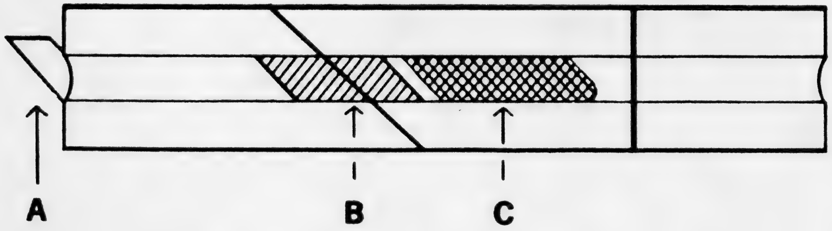


Fig. 2

Holding the position locating Tab "A" in place with one finger, press the white splicing tab "B" down firmly by running another finger-or-thumb nail back and forth over it a few times until the white splicing tab "B" takes on the color of the recording tape under it. Once this has been accomplished, pull the spliced tape taut and lift it up and out of the block – then peel off the clear backing of the Editab from the transparent end

(position locating tab "A" end) to the end of the red portion of end "C" Your splice will now be complete, and the splicing tab should be centered exactly over the center of the diagonal cut.

If Editabs are not going to be used but splicing tape is, it should be of approximately one inch in length and 7/32" wide for splicing ¼" tape. The splicing tape should be applied so as to allow 1/64" clearance at each edge so that possible oozing or "bleeding" of the adhesive does not cause wow on flutter during playback.

VI
Editing Tape

All of the details for editing tape cannot be fully explained in these instructions. A more complete booklet on the subject is available which will enable the beginner and semi-professional to learn in a few minutes the proper procedures to be followed. However, the EDITall Splicing Blocks have been designed primarily with proper and easy editing in mind and it is therefore important that if the EDITall Splicing Block is mounted onto a tape recorder, it should be done correctly the first time.

VII
Mounting Instructions

The EDITall Block is designed to be fastened to the top of the tape recorder. On some brands or models the location is extremely convenient, while on others less convenient and even impossible. This depends on the size and design of the respective model. If it is not possible to mount on the recorder, the EDITall Block can still be used without being mounted, or mounted in a convenient location near the recorder. When mounting on the recorder (See Fig. 3), the block should preferably be fastened to the right of the playback head if, as is usual, the direction of tape drive is from left to right as you face the recorder. The block should be mounted so that its diagonal cut is to the left and the 90 degree cut to the right. EDITall

Models S-2 and KS-2 are provided with double-sided adhesive strips already attached to their bottoms. Just strip off the paper backing and press the block down firmly where you want it to remain, first cleaning the area of dust, oil or grease. All other EDITall Blocks have mounting holes.

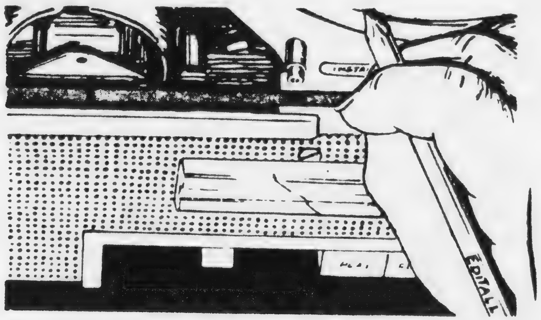


Fig. 3

VIII

How to Mark Tape

In order to know where to cut the tape, it is necessary to mark it while it is in operation on the recorder. The tape should be marked with a special grease pencil which is included with all EDITall Kits. The best method of marking the tape is to establish a special "marking-point" away from the playback head of the recorder.

IX

How to Measure the Playhead-to-Marking-Point Distance

Since sound is reproduced at the magnetic gap of the playback head, you must know where this gap is in order to edit tape accurately. On most professional three-head machines, the playback head gap can be seen through a magnifying glass powerful enough to make a slit a fraction of a thousandth of an inch visible! The distance between it and a spot to its right where the tape can be marked may be accurately measured. The

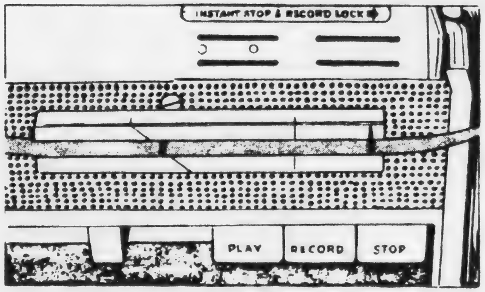


Fig. 4

distance is then marked off on the EDITall, beginning from the center of the diagonal cut and measuring to the right. On all recorders you must measure this distance so that you can mark the tape for cutting easily, without removing the head assembly covers every time you edit tape. Once you have measured the space between the gap and a convenient tape-marking spot and reproduced the distance on your EDITall. you need not ever again remove the headcover for editing. In figure 3 (looking at the front of a recorder – the tape has been flipped over for illustration purposes) the right hand mark on the tape was made while it was pressed against a headcover mounting stud which happened to be in a convenient place for marking tape for editing. The left hand mark was made on the tape directly over the playback head gap.

With modern short magnetic gaps it is impossible to see the gap without using a magnifying lens. In that case use the following audio method: Record a few seconds of a continuous sound on scrap tape. This sound may be oscillator tone, pitch pipe – any continuous sound. Place this tape in the EDITall and cut into the middle of it, cutting it at the 90-degree (straight across) slot. Then splice a length of leader tape to this tone tape and play it back on your machine. Do this by turning the reels by hand, so that you can stop the tape just as soon as you hear the sound. At this point the splice should be directly over the gap of your playback head. Don't move the tape! Then mark it at the spot you have picked previously to be the tape marking spot. Now remove this marked tape from the recorder and place it in the EDITall, with the perpendicular splice precisely centered so that it bisects the middle of the diagonal slot on the block. Then mark the EDITall at the place where the other mark on the realm of "serious" electronic music, which ventures to aspire beyond the sound-effects rather easily obtained by any synthesizer aficionado, the composer presumably is concerned ultimately with creating an individual art work bearing the thumbprints of his or her creative personality, and also representing those techniques leading toward its expression in the medium of electronic music. Any technological means which brings the composer closer to the desired musical goal is equally valid, including various complexities of synthesizer, computer, and tape techniques without the need for apologies for the means used or the false supposition one is somehow more superior musically than another. Ultimately, creative talent combined with craftsmanship is essential, since a musically promising work which assaults the listener's perceptual fluency with a cannonade of technical flaws, misjudged phrase lengths and balance, and a plethora of various compositional deficits, may have no advantage over a technically perfect but musically sterile one.

In the quest for individual expression in the medium of electronic music, it is impossible to discount the reality of resultant sound textures and patterns recognized as typically characteristic of synthesizer design, which are intended to be readily duplicated by anyone familiar with any one synthesizer and its typical patching routines, and are inevitably unoriginal. Likewise, it is impossible to discount the synthesizer's considerable utility and convenience, for instance, when used to produce multi-layered, rapidly moving, intricate pitch patterns, each with its own rhythmic scheme, timbres, and amplitudes creating an elaborate, amorphous soundscape whose realization on a synthesizer may take only several minutes of control setting compared with several hours perhaps of incessant drudgery of tape recording, overdubbing, and splicing to achieve a similar sound result in the classic tape studio. However convenient streamlined automation may be for creating complex sound patterns, it can also result in mono-textural, monotonous rhythmic patterns, and seemingly endless and aimless perpetual motion, randomly-generated patterns eventually rambling on to a long-distant *al niente*. When compositional revisions are necessary, and the work exists only as a loosely structured real-time event, there is, consequently, little chance for the kind of thorough editing and redesign based on repeated playback which is possible with electronic music sounds stored on tape.

Lacking the convenience of prepackaged synthesizer patching routines, a composer learning the art of electronic music composition in the down-to-basics environment of a conventional classic tape studio (minus synthesizer) might be more economical, selective, and even by necessity, more creative in choosing and dealing with sound materials when faced with the time factor, alone, in conventional tape recording, manipulation, and editing techniques involved in producing original sound materials "from scratch." By retaining and exercising basic editorial control (including tape splicing procedures) over the simpler and more complex stages of a sound material's development from the beginning of his studio experience, the composer is able to gradually refine his skills of creative selection from the sounds available on tape. By taking the time to evaluate and redesign juxtapositions of electronic music sounds on tape through repeated listenings and editing, it is possible to strike a balance between the rational and intuitive aspects of compositional creativity in terms of the musical work at hand. The experience gained by such a close encounter with the generation and recombining of sounds on tape early in the composer's electronic music studio work may prove to be of essential value in any future dealings with sound materials generated by *any* technological means within the realm of electronic music. Synthesizer or computer generated sounds may be stored on tape in a "sound bank" for immediate or future use in composing a work. Individual sonorities or entire sound passages may be selected and spliced to form the final sound image, or simply, splicing may be used for final touch-ups of an existing tape. Uniquely, tape splicing itself may generate new *hybrid sound sequences* (composed of juxtapositions of diverse sounds) which are not available by any other means. That is, the sounds in the sequence will not ordinarily occur as the result of an automatic process of generation and actually have to be spliced into a sequence in order to exist as a sequence.

With magnetic tape as the primary sound storage medium, splicing is the constituent part of editing giving the composer a tool similar to a painter's brush or a sculptor's chisel for addition and deletion of sounds during the creation of an electronic music work, or at any time afterward. So, dust off that splicing block, demagnetize the razor blade, play back that phrase which did not sound quite "right" and experience the joy of splicing — or rather, its artistic rewards.

sound thinking

ROBERT ANGUS

CHOOSING THE RIGHT RECORDING TAPE

Whether you're preparing a recording for audition purposes or simply taping a practice session so that you can hear your mistakes when you play the tape back, sooner or later you're going to come into contact with a tape recorder and recording tape. When you do, you'll discover that there are dozens of different brands of tapes, with most manufacturers offering 2 or 3 or 4 different types. You can pay as little as 79¢ for a 60-minute blank cassette, or $12 or more for a 7" reel of tape. Which one do you need for which recording purpose?

Magnetic tape is more than a strip of plastic with some iron rust on it. The kind of iron rust, the precision with which the particles have been milled and glued to the tape are all important. So are the tensile strength of the plastic film and the precision of its dimensions. In the case of cartridges and cassettes, the quality of construction of the plastic shell and the correct use of parts also affect how they'll perform in your recorder.

Most magnetic tape uses ferric oxide (or iron rust) as the recording agent. Some newer high fidelity tapes use ingredients like chromium dioxide and cobalt; we'll discuss them in greater detail later on.

Iron oxide consists of millions of microscopic needle-shaped particles of iron. As these needles pass the electromagnetic recording head of a tape recorder, they become magnetized — just like a bar magnet, with one positive and one negative pole — and arrange themselves in magnetic patterns. When they pass the playback head, they induce tiny electrical signals which the recorder and amplifier boost into signals strong enough to drive a loudspeaker.

The more uniform the magnetic particles, the more uniform the frequency response of the tape recording is likely to be. To make particles as uniform as possible, tape manufacturers mill their oxides in rotary tumblers much like those used to make cement. The better the quality of ingredients put into the mill in the first place, and the longer the milling process, the better the oxide coating and resulting recording are likely to be — and the more expensive the tape.

Uniform particles also make it possible to pack each particle closer to its neighbor, thus reducing the tape hiss which exists in all tape recordings. By increasing the number of magnetic particles in a given area of tape, it's possible to record more signal on the tape in relation to the gaps in between, which produce hiss.

The result is that most tape manufacturers offer at least 2 grades of iron oxide recording tapes — an inexpensive utility grade, suitable for recording speech and for general non-musical recording; and a quality grade, suitable for high fidelity music recording. The utility grade usually is perfectly satisfactory for recording musical practice sessions, where purity of tone is not crucial, and where you're not going to be listening to the playback more than two or three times. It can capture and reproduce your mistakes and it does so inexpensively. The catch with cheap tape — whether it comes on open reels, in cartridges or cassettes — is that it may use cheap materials. These may be cheaper — but they also may shed oxide on your recorder heads and working parts; the cassettes or cartridges may use inferior parts which cause them to jam after several playings; the tape itself may be slit unevenly, making it ride up and down on the tape guides, or cause them to wear unevenly. Hence it pays to stick with the utility grades of brands you know, rather than buying the so-called white box bargain tapes.

Manufacturers usually label their better grade of iron oxide tape "low noise," "high density," or some similar term. One sure way to tell them from the utility grades is by their higher price tag. For that you get a tape which has been calendered to remove excess iron oxide, a tape which provides smooth, uniform frequency response with much less tape hiss than the utility grades can offer. It's suitable for making audition recordings, ideal for high fidelity music recording. Actually, manufacturers of premium-quality tape like Maxell, TDK, Scotch, Fuji, Ampex, BASF and others offer at least 2 grades of low noise/high energy tape — one at an intermediate price, which combines economy with high fidelity performance that is less than the ultimate; and a premium-priced product which incorporates the latest refinements in oxide, coating and construction techniques.

Several years ago a new recording substance, chromium dioxide, appeared on the market. Chromium dioxide is significantly more expensive to produce than ferric oxide, but it yields better high frequency response and lower hiss levels than are possible with most iron oxide tape. However, while most iron oxide tapes use a similar high frequency bias signal in the recording process, chromium dioxide requires a much higher bias signal. Chromium dioxide has certain drawbacks. It's somewhat more abrasive than ferric oxide, making for more head wear particularly on open-reel recorders; and it's more difficult to erase than ferric oxide. At present chromium dioxide tape is available only in blank cassettes, where it costs about 30 percent more than the better grades of ferric oxide tape.

In order to take full advantage of chromium dioxide's superior recording qualities, however, you've got to own a recorder with a chromium bias switch. Several 1976 models feature automatic bias switching — among them Dual, Yamaha, Sony, Teac and others — while most better-quality cassette decks come with bias switches.

Another disadvantage of chrome is that while it's able to record high frequencies with greater fidelity than ferric oxide, it doesn't do as well by the bass. So Sony developed a tape which consists of a thin layer of chromium dioxide on top of a layer of ferric oxide, thus combining the advantages of both. Ferrichrome tape now is available from such manufacturers as Scotch, Meriton and BASF in addition to Sony. Like pure chromium dioxide, Ferrichrome requires special biasing, which means that if your recorder isn't equipped with the necessary switch, Ferrichrome may not perform as well on it as will some of the less expensive iron oxide tapes. On machines which are designed to accommodate it, ferrichrome can produce recordings which sound very good indeed.

Finally, there's cobalt, an ingredient several manufacturers have tried to add to ferric oxide because of its superior ability to become magnetized. Unfortunately, while cobalt magnetizes more rapidly than iron oxide, it also tends to lose its magnetic charge, a fact which makes it difficult to work with. Cobalt particles also tend to coalesce on the tape, so that some spots exhibit different recording characteristics than others, making for an uneven recording. Maxell claims to have

(continued on page 46)

solved the problem by encapsulating cobalt particles with a coating of iron oxide in the construction of its UDXL tape, while several other manufacturers say that refined milling procedures reduce both the problems of signal loss and coalescing.

There are considerations in addition to the tape oxide. If you own an open reel recorder, you must be concerned about the slitting of the tape. It must be precisely .246" wide — not .251", in which case it will wear the tape guides; or .241", in which case it will ride up and down as it passes the heads, making for an uneven recording. The standard brands are careful to slit their tapes carefully. Some bargain tapes actually are reject instrumentation tape, cut down for audio use — which means that almost invariably they're too wide for the tape guides.

Tape cartridges and cassettes become even more complex. The shell actually becomes part of the recording system when you place one in your recorder. A poorly designed shell can interfere with the free movement of even the best tape, resulting in jamming or excess wow. Conversely, a really well-made shell can permit a mediocre iron oxide tape to produce surprisingly good results. Unfortunately, the average user can't tell just how good the shell is without looking inside, and in most cases that's impossible. Suffice it to say that it costs more to make a shell properly, and to put in all the parts — such as slip sheets, steel pins, delrin rollers and the like — than to mass produce a slipshod one. That cost generally is reflected in the higher price of the blank cartridge or cassette.

Which tape type is right for you? It depends on the use you have in mind, the length of recording time you need, and the machine you're using. There is no single "best" tape. When I conducted tests on 18 cassette tapes recently using 3 popular cassette decks, I found that there was remarkable similarity in performance among the best — but that their relative standing varied from one recorder to another.

If you really want to find out which tape will perform best on your recorder — whether it's a high fidelity demonstration tape you're recording, or simply a rehearsal you want to record cheaply, to pick out the flaws — your best move may be to try several popular brands before settling on the one which produces the results you like best. Record the same passage on each sample tape, then play them back, one after the other. If you own an open reel recorder, it's a simple matter to splice sample lengths of different tapes together so that you can compare directly. Direct comparisons of this type aren't possible with cassette or cartridge tapes, but you can compare one brand with another as quickly as you can change tapes. □

CASSETTE TAPE PRODUCTS

maxell®

maxell XLI-S 90

XLI-S Normal Bias and Equalization
(120 microseconds)

Especially designed for music with a powerful high frequency content - heavy rock, disco, big band, jazz etc.

Max. recording level + 6 dB

NORMAL POS.

maxell XLII-S 90

XLII-S High Bias and Equalization
(70 microseconds)

The most "silent" tape in the Maxell series: extra clarity with crystal clear high end without tape hiss.

Max. recording level 0 dB

CrO2/HIGH POS.

maxell MX 90

MX High Bias and Equalization
(70 microseconds)

For purest reproduction of both high and low frequencies. Ideal for recording live music and direct from high quality sources.

Max. recording level + 10 dB

METAL-POS.

maxell UDS-I 90

UDS-I Normal Bias and Equalization
(120 microseconds)

All round tape. Low noise level. Very suitable for most types of music - soft or loud.

Max. recording level + 2 dB

NORMAL POS.

maxell XLII 90

XLII High Bias and Equalization
(70 microseconds)

Ideal for music with many soft passages or for solo instruments

Max recording level 0 dB

CrO2/HIGH POS.

maxell UR 90

UR Normal Bias and Equalization
(120 microseconds)

For dictation and music without much volume variation, e g. pop, light music. Not for very soft or very loud passages.

Max. recording level 0 dB

NORMAL POS.

maxell XLI 90

XLI Normal Bias and Equalization
(120 microseconds)

Maxell lowers the noise barrier Perfect reproduction of today's modern music-disco, rock, pop etc.

Max. recording level + 4 dB

NORMAL POS.

maxell UDS-II 90

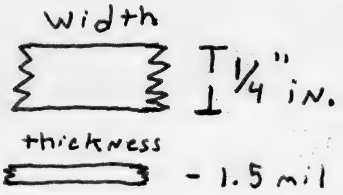
UDS-II High Bias and Equalization
(70 microseconds)

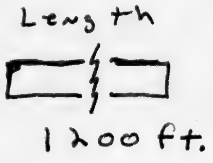
Fine all purpose tape for excellent recording on decks with high bias settings.

Max. recording level 0 dB

CrO2/HIGH POS.

Tape Dimensions





Tape Composition

Dark: Plastic

Light: Fe^2O^2
Ferric Oxide
or
Iron Rust

The tape must have good Magnetic qualities, since the electrical impulses must remain on the tape.

Misc.

runs @ 7.5ips
or @ 15ips

Chromium is very good for high's, but not for bass, & wears quickly.

Ferrochrome - Ferric Oxide & Chromium

Bulk Eraser

1. Plug it in
2. Turn it on
3. Put reel on & turn it around
4. turn it around & turn it again.
5. remove reel before turning off
6. Turn off & unplug

flutter

a screwed up capstan; motor is running incorrectly

WoW

A problem with the supply or take-up reel; uneven reel motion

Cross-Talk

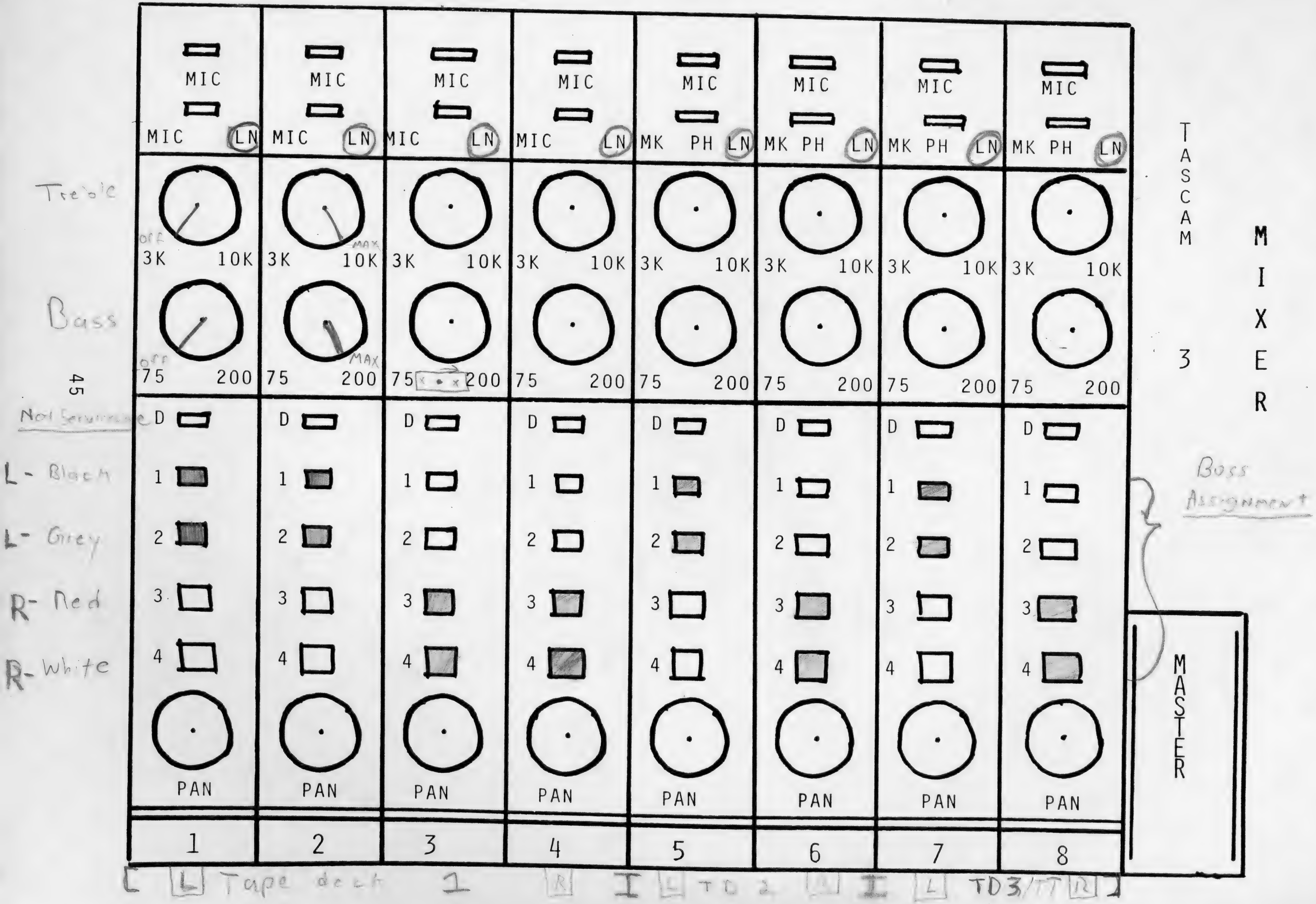
Unaligned heads, which results in misaligned channels

Print Through

When a sound gets through tape on a reel when sitting on shelf for long periods, cheap tape.

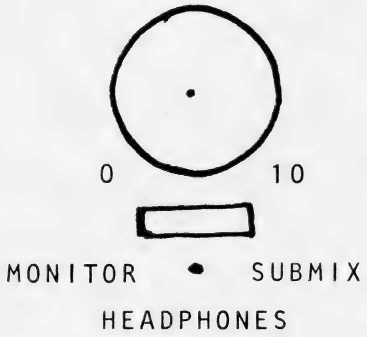
MIXER - Playback Only

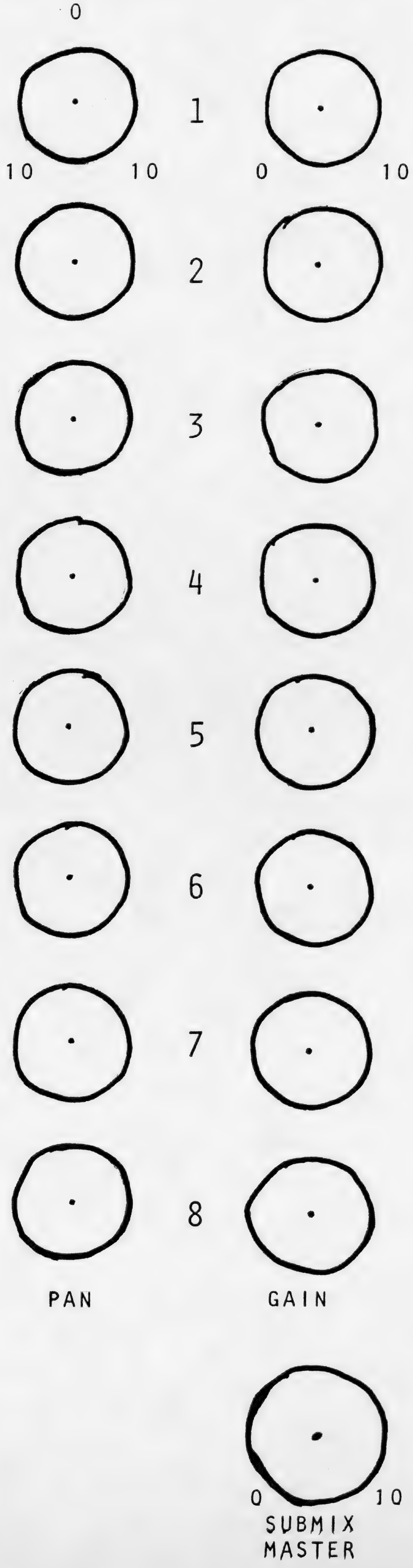
Linear Slide-fader


TASCAM 3
MIXER
MIC
MIC
LN
MK
PH
Treble
3K
10K
off
MAX
Bass
75
200
Not Serviceable
D
1
2
3
4
L- Black
L- Grey
R- Red
R- White
PAN
1
2
3
4
5
6
7
8
Boss Assignment
MASTER
[L Tape deck 1 R] [L TD 2 R] [L TD3/TT R]

TASCAM MIXER 3

USE OF SUBMIX


0
10
MONITOR
SUBMIX
HEADPHONES


0
1
10
10
0
10
2
3
4
5
6
7
8
PAN
GAIN
0
10
SUBMIX
MASTER

BEFORE STARTING ANY TAPE PROJECTS........

DO THE FOLLOWING.....

Check Speed 4.5

1. Using TAPE DECK 2, record your name on the left track at least six times.
2. Use SCOTCH 250 tape to do this
3. Leave a small space (about 2 inches) between your name. After it has been recorded, make a mark between each section.
4. Transfer this tape to a small, 3" reel, and keep it in your drawer.

You will use this tape at the start of each of your Projects. It is to be preceded by leader tape before turning in final projects.

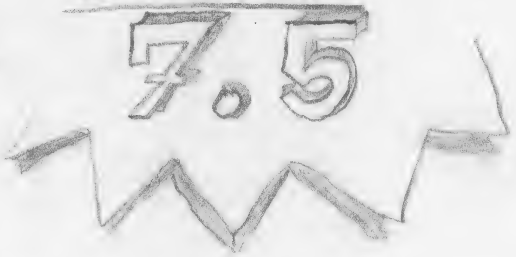
Be certain that your mike recording is at a good level, and does not contain any outside noises.

Leave some tape room from the end of your name to the start of your actual project.

Nov. 4

ELECTRONIC MUSIC I

Heads Out!



TAPE PROJECT NO. 1

DIRECTIONS -

1. Using the two track, two channel tape deck, record your voice counting from one to 10 on the RIGHT Channel. Keep your counting at a very strict, even pace.

2. After playback is checked, splice out numbers 2, 4, 6 and 8.

   No splice!

   Numbers 1, 3, 5, 7, 9 and 10 should be at a very even pace - if spliced correctly.

3. Splice together Nos. 2, 4, 6 and 8 so that they will appear on the LEFT Channel. (In order and forward)

4. When completed, place the tapes together so that the odd numbers are heard, then the even ones. Do not use the mixer.

5. Place on the master reel with leader tape at the start of your project. Write your name on the leader tape. Also place leader tape at the end of your Project, but do not write on it.

PROJECT TO BE COMPLETED BY____________________.

ELECTRONIC MUSIC I

GRADING OF TAPE PROJECT NO. 1
(Number Splicing)

____
Technicians Name

	SPLICING	EDITING (*)	GENERAL
L - 1	E G F P	E G F P	
1 - 3	E G F P	E G F P	
3 - 5	E G F P	E G F P	
5 - 7	E G F P	E G F P	
7 - 9	E G F P	E G F P	
10 - 2	E G F P	E G F P	
2 - 4	E G F P	E G F P	
4 - 6	E G F P	E G F P	
6 - 8	E G F P	E G F P	
8 - L	E G F P	E G F P	

Followed Directions............. EEE GGG FFF PPP

General Quality of Project....... EE GG FF PP

E = 4
G = 3
F = 2
P = 0

(*) EDITING includes spacing, lack of unwanted sounds, complete "number", and proper tape technique for Nos. 2, 4, 6, 8.

TOTAL POINTS ______________

FINAL GRADE ______________

ELECTRONIC MUSIC I

2
7.5
5
37.5

TAPE PROJECT NO. 2

USE OF FOUR TRACK RECORDER

PART I

Directions - Record the following sounds, as indicated on the tracks as listed.

TRACK 1 - Paper clips-Box

TRACK 2 - Clapping

TRACK 3 - Coughing

TRACK 4 - Humming

The above sounds are to be heard one right after the other, and there are to be no "other" sounds on the tape. (5 seconds).

PART II

Directions - Combine the above four sounds (on the same tracks as above) so that they will all begin EXACTLY AT THE SAME TIME. (5 seconds)

DATE DUE________________

ELECTRONIC MUSIC I

DEC. 4th

TAPE PROJECT NO. 3

USE OF FOUR and TWO TRACK RECORDER

DIRECTIONS -

LEFT CHANNEL - Paper Clips
Clapping
Coughing
Humming

RIGHT CHANNEL- Bell
Slide whistle
A Passionate Moan
Sound of your choice

All Sounds are to start exactly at the same time. The sounds on the right Channel are to be ONE OCTAVE higher than originally recorded.

All sounds are to begin and end exactly at the same time. (5 seconds)

No "other" sounds are to be heard on the tape.

DATE DUE______________

TAPE PROJECT NO. 2

Name ____________________

Part I (50%)

GENERAL INFO

(5 points each)

UNWANTED SOUNDS..... 1 3 5

1. MATCHES (L)......... 1 3 5

UNWANTED SOUNDS..... 1 3 5

2. CLAPPING (L)........ 1 3 5

UNWANTED SOUNDS..... 1 3 5

3. COUGHING (R)........ 1 3 5

UNWANTED SOUNDS..... 1 3 5

4. HUMMING (R)......... 1 3 5

UNWANTED SOUNDS..... 1 3 5

BALANCE and
GENERAL RECORDING
QUALITY (Hiss)...... 1 3 5

____
Pt. I TOTALS

Part II (50%)

(10 points each)

SOUNDS START TOGETHER 2 5 8 10

BALANCE OF AMPLITUDE 2 5 8 10

SOUNDS END TOGETHER 2 5 8 10

QUALITY OF RECORDING 2 5 8 10

FIVE SECONDS IN LENGTH 3 10

____
Pt. II TOTALS

General Grading:

1. Followed directions
2. Unwanted sounds
3. Tape quality
4. Recording quality
5. Use of Simul-Sync

____
GRAND TOTALS

TAPE PROJECT NO. 3

Name ____________________

Unwanted Sounds 1 5 10

LEFT CHANNEL RECORDED 3 5 7 10

RIGHT CHANNEL RECORDED 5 10 15 20

Unwanted sounds 1 5 10

Balance of Amplitude 1 5 10

Followed Directions 5 10 15 20

Timing accurate (5 sec.) 1 5 10

General Recording Quality 1 5 10

TOTAL POINTS ____________

TAPE PROJECT NO. 4

Name ____________________ Position ____________

DOUBLE ECHO ON RIGHT CHN.	20	15	10	5	0
DOUBLE ECHO ON LEFT CHN.	20	15	10	5	0
LEVEL BALANCE ON RIGHT	20	15	10	5	0
LEVEL BALANCE ON LEFT	20	15	10	5	0
LEVEL BALANCE OF BOTH CHN.	20	15	10	5	0

TOTAL POINTS ____________

TAPE PROJECT NO. 4

LINE ECHO and "DUBBING"

Record a triple line echo using your voice in counting from ONE to TEN as follows:

Track 1	ORIGINAL
Track 3	First ECHO
Track 2	Second ECHO
Track 4	Third ECHO

Use the mike cable for the original recording. There is to be absolutely NO OUTSIDE NOISE or SOUNDS on your tape.

All four tracks are to be equally balanced and "dubbed" and reduced to half-track playback. ~~When you "dub", you are to use the *SCOTCH 250* tape.~~ Balance all four tracks on the mixer, and equalize if you feel it is necessary, but be certain that ALL FOUR TRACKS are equal in amplitude.

Place the finished "dubbed" tape on the special reel with six inches of leader tape before and after. Write your name on the "head".

DATE DUE______________________

GLOSSARY OF TAPE TERMINOLOGY

A/B test - A listening test in which two similar audio devices (or program sources) are compared by rapidly switching between them while the rest of the system is unchanged, except for relative volume adjustment if needed.

acetate - Cellulose acetate, an inexpensive, transparent plastic film used as the backing material for many recording tapes.

ALC - Abbreviation for automatic level (volume) control. A special compressor or limiter circuit included in some tape recorders, for automatically maintaining the recording volume within the required limits regardless of changes in the volume of the sound.

alignment - In a tape recorder, the physical positioning of a tape head relative to the tape itself. Alignment in all respects must conform to rigid requirements in order for a recorder to function properly.

amplify - to increase levels, as with a volume control

attenuate - to decrease levels, as with a volume control

automatic reverse - ability of some four-track stereo tape recorders to play the second pair of stereo tracks automatically, in the reverse direction, without need to interchange the empty and full reels after the first pair of stereo tracks has been played.

automatic shutoff - device incorporated into most tape recorders that automatically stops the machine when the tape runs out or breaks. It is usually a mechanical switch.

azimuth - the angle of a tape head's pole-piece slot relative to the direction of tape travel. See "alignment."

backing - flexible material (usually cellulose acetate or polyester) on which is deposited the magnetic-oxide coating that "records" the signal on the tape. Also known as "base."

balance - relative volume, as between bass and treble or different voices and instruments. Also applied to the relationship between left and right channels in stereo and between all four channels in quadriphonics.

balanced output - a three-conductor output, as from a microphone, in which the signal voltage alternates above and below a third neutral circuit. This symmetrical arrangement tends to cancel any hum picked up by long lengths of interconnecting cable.

bias - a critical amount of voltage applied to a device to prepare it for correct performance. In tape recording, the bias is a constant magnetic field applied to the tape to enable it to respond more completely and more accurately on the fluctuating magnetic impulses of the audio signal. Although sometimes a DC (fixed-magnetic-polarity) field, the ideal bias is provided by an ultrasonic alternating-polarity field of 50,000 Hz or higher frequency.

✓ bidirectional microphone - a microphone that is equally sensitive to sounds arriving at it from in front or in back but discriminates against sounds arriving at it from the sides. See "polar pattern."

binaural - literally, two-eared. Binaural recordings are made with two microphones in locations simulating those of the human ears, and are intended for reproduction through headphones.

boom - a long, horizontal extension from the top of a microphone stand, usually counterweighted, to allow a mike to be positioned above a sound source located some distance from the sound. Also, the excessive bass response characteristic of some microphones when placed too close to the sound source.

● bulk eraser or degausser - a device for effecting the erasure of an entire tape recording without requiring that the tape be unwound.

● capstan - the motor-driven spindle that feeds a tape at constant speed past the machine's heads. The tape is usually gripped between the capstan and a soft-surfaced pinch wheel or "idler" to minimize slippage at the capstan.

✓ cardioid microphone - a microphone having a "heart-shaped" polar response pattern and therefore offering its greatest sensitivity at the front, little or no sensitivity toward the back. Also known as a directional microphone.

cartridge - in tape, any enclosed "package" containing a length of magnetic tape and its basic winding receptacles designed to eliminate the need for handling or threading the tape. Specifically, the word "cartridge" is used to describe that variety of package that contains a continuous loop of tape.

cassette - a sealed "package" instant-load cartridge containing a length of tape and separate supply and takeup reels or hubs. Cassettes, unlike continuous-loop cartridges, can be rewound.

● channel - a single, complete through - path as from microphone to loudspeaker. A four-channel, or quadriphonic, recorder has the necessary separate through-paths to record and reproduce four-channel stereo.

● channel separation - the degree to which stereo channels are kept apart from each other. Expressed in decibels; the greater the number, the better. See also "crosstalk."

coating - the magnetizable material on one surface of a recording tape which stores the audio signal when recording.

✓ condenser microphone - a microphone whose transduction principle is based on the varying electrical charge across a sound-modulated capacitor.

cps - abbreviation for cycles per second (of frequency) an obsolete term. Now called hertz, abbreviated Hz.

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coating - the magnetizable material on one surface of a recording tape which stores the audio signal when recording.

✓ condenser microphone - a microphone whose transduction principle is based on the varying electrical charge across a sound-modulated capacitor.

cps - abbreviation for cycles per second (of frequency) an obsolete term. Now called hertz, abbreviated Hz.

crosstalk - leakage of recorded signal from one channel of a stereo device into the adjacent channel or channels. Crosstalk between stereo channels impairs stereo separation; crosstalk between reverse-direction tracks causes the reverse track signal to be heard, backwards, during quieter parts of the desired program.

cueing - locating a particular spot on a recorded tape, preparatory to playing through from that spot.

decibel - abbreviated dB, the decibel is a unit of change in the intensity of a signal. An increase in intensity is expressed as a + number of dB, a decrease by a - number. No change is stated as 0 dB, and 0 dB also indicates a starting level from which changes are measured. Note that a two-to-one change in power is 3 db, a similar change in voltage is 6 dB. The smallest change the ear can hear is said to be 1 dB. A doubling of perceived loudness is about 10 dB.

deck - a term usually applied to a tape machine having no built-in power amplifiers or loudspeakers of its own, but intended rather for feeding a separate amplifier and speaker system, as in a component installation.

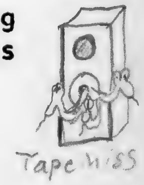
DIN - letters stand for Deutsche Industrie Norm and designate performance standards followed in Europe as well as the type of unitized connecting plugs and mating sockets in which a number of pins and holes enable more than one function or more than one channel to be handled by a single connector.

directivity - a tendency for some microphones to respond less strongly to sounds arriving from the sides and/or rear. Directional microphones are useful in discriminating on the basis of direction between wanted sounds (musical instruments) and unwanted sounds (audience noises). Directivity is typically graphed on a "polar pattern" and is thus classes as nondirectional (omnidirectional), bidirectional (figure-8), unidirectional (cardioid), supercardioid, or hyperdirectional.

distortion - any measurable or audible difference between the output of an audio device or system and the signal entering it. Distortions of various kinds are always present to some degree, but careful design can keep them sufficiently low as to be inaudible or barely so.

Dolby - a device that increases the signal-to-noise ratio of a recording medium by raising the volume of quiet passages prior to recording, and lowering them to their original levels during playback. The lowering process automatically reduces any noise that was introduced as a result of the recording or playback processes. The Dolby A equipment in professional use suppresses noise over the entire audible frequency range; home Dolby B equipment affects only the upper range characteristic of tape hiss.

dbx



Dolbyized tape - a recorded tape with Dolby compression added for low-noise playback via a Dolby-B stretcher.

double-play tape - tape having half the thickness and hence double the running time (for a given reel size) of standard 1½-mil tape.

● dropout - a momentary loss of volume or treble response due to a brief separation of the tape from the surface of the record or play head. A very slight separation causes a treble dropout; more severe loss of head-to-tape contact causes the whole signal to drop out. Dropouts can be caused by buckled or crinkled tape, lumps or pits in the magnetic coating, or detached clumps of oxide passing across the head surface.

● dub - a copy of another recording.

✓ dynamic microphone - a microphone using a permanent magnet and a vibrating coil or ribbon as its transducing system.

dynamic range - the span of volume between the loudest and softest sounds in an original signal or recording or playback equipment. Dynamic range is respressed in decibels. See "signal-to-noise."

● echo - in tape recording, this refers to a provision for picking up some of the sound from a play head while recording and feeding it back to the record head to produce a rapidly periodic repetition of each sound. Correct echo-volume adjustment causes a "decay" of the repeated sounds to simulate acoustical reverberation.

editing - the rearrangement of recorded material to provide a change of content or form, or for replacement of imperfect material. Usually accomplished by cutting and splicing the tape.

● equalization - altering the frequency characteristic of a signal or audio device to meet specific requirements. In tape recording and playback, correct equalization, together with correct bias, are essential to realizing optimum performance from a given magnetic tape. The circuitry for doing this is included in the tape preamplifier supplied as part of a specific tape deck. The term equalization also applies to special auxiliary networks or devices which, inserted into a playback system before the loudspeaker and/or power amplifier, may be used to modify the system's sound to compensate for variations in program material, room acoustics, and the response of individual components in the system. These devices can do so more precisely and more effectively than conventional tone controls.

erasure - the elimination of recorded signal from a tape, generally to allow for reuse of the tape for a new recording. Erasure is generally accomplished by exposing the magnetic coating to a very strong magnetic field of alternating polarity and then gradually reducing the strength of the field to zero, to leave the tape in a neutral (no magnetization) state. Virtually all recorders use a special erase head to obliterate the previously recorded signal before the head lays down the new signal. A bulk eraser is a device that can erase an entire reel of tape at once.

expander - a device that automatically widens the dynamic range of an audio signal, making loud passages louder and soft passages softer.

extra play - thinner tape (1 mil) than "standard play" (1½ mil) allowing 50% greater playing time for a given reel size.

fast forward - high-speed winding (shuttling) of tape from the supply reel onto the takeup reel.

● feedback - a build-up of system energy due to an output signal getting back into the input of the system. In recording, feedback is most likely to occur when a recording microphone picks up sounds from monitoring loudspeakers and feeds them back through the recording system to the loudspeakers again, producing a loop of energy reinforcement.

feed reel - the reel from which the tape unwinds while playing or recording.

flange - the side of a tape reel that prevents the tape on the hub from slipping sideways off the "pie".

four-channel sound. See "quadriphonic sound".

four-track recorder - see "track configuration."

● frequency - repetition rate of any periodic phenomena, as an alternating electrical signal or sound vibration, expressed in hertz (Hz), formerly cycles per second. Bass frequencies in music extend from about 20 to 200 Hz. Middle or midrange frequencies occupy the 200 Hz to 3,000 Hz range, while tones above 3 kHz are regarded as the treble or high-frequency range.

● frequency range - the span of frequencies, from lowest to highest, that any audio device or system will pass without substantial loss. An essentially meaningless "specification", since it lacks any indication of what constitutes a "substantial" loss.

● frequency response - the measure of ability to pass signals of different frequency without affecting their relative strengths. This is shown as a graph or "curve" which assumes input signals equally strong at all frequencies, and plots their output intensities against a decibel scale. The ideal "curve" is a straight line (perfectly "flat" response). Frequency response generally is stated with specified decibel limits indicating the maximum deviations from flat response. For instance, 30 to 18,000 Hz ± 2 dB means that the audio device or system will not change the relative intensities of any frequencies within that range by more than 2 dB above or 2 dB below the zero-dB (volume unchanged) level.

full-track recording - a recorded signal occupying the full width of a quarter-inch tape. See "track configuration."

gain - the increase in signal provided by an amplifier between input level and output level.

gap - the tiny space between the pole pieces of a record or playback head, across which the magnetic fields appear (when the tape is running) for transduction into alternating electrical signals on playback or into a magnetic pattern on the tape during record.

● generation - the number of dubbing steps between a master recording and a given copy of the master. Thus a second-generation dub is a copy of a copy of the original master.

ground - a point of zero voltage, usually the metal chassis of an electrical device.

half-track recorder - normally a monophonic recorder where the recording head covers slightly less than half the width of standard quarter-inch tape, making it possible to record one-track or the tape in one direction and, after turning the reels over, a second track in the opposite direction. Also referred to as "two-track" recorder.

~~harmonic~~ - a tone whose frequency is a multiple of another, lower-frequency tone (fundamental). Musical sounds are composed of a fundamental and a number of harmonics.

harmonic distortion - a form of electrical distortion characterized by the addition of spurious harmonics to the signal. Expressed as a percentage - the lower the number, the better.

head - in a tape recorder, a small magnetic transducer. Specialized types of heads are used for erasing the tape, recording a signal on it, and playing back the signal from it. In many recorders, the recording and playback functions are both performed (at different times) by the same head.

head degausser - a special demagnetizer with elongated pole pieces enabling them to be brought into proximity to head surfaces for elimination of the built-up magnetic "charge" that develops over a period of time as a result of asymmetrical electrical inputs signals.

head room - the "safety margin" that is normally provided between the "maximum recording level" as indicated on a recorder's level indicators, and the actual point of severe tape overload. Most good recorders provide 6 to 8 dB of head room above the indicated zero-VU or normal maximum indicated recording level, to allow for the inability of the VU meter's needle to respond fully to sudden, intense bursts of signal energy.

Peaks to distortion

hiss - the primary background noise in tape recording, stemming from circuit noise in the playback amplifiers or from residual magnetism of the tape.

hub - the center section of a tape reel around which the tape is wound.

hum - a continuous low-frequency interference caused by inadvertent pickup of 60-Hz or 120-Hz from nearby AC power sources.

Hz - abbreviation for hertz, meaning cycles per second of any periodic phenomena such as audio frequencies. See "frequency".

impedance - essentially, opposition, the flow of alternating current, and consisting of "pure resistance" combined with inductive and/or capacitive resistances. Impedance values are specified for some components when it is important for their proper functioning that their interconnection with another component provide an equivalent termination or load impedance. Also known as the "load" on a circuit or audio device, expressed in ohms.

input - terminals, jack, or receptacle provided for the introduction of an electrical signal into an audio device.

intermodulation (IM) distortion - the introduction of spurious signals as the result of interaction between two or more simultaneously reproduced tones, causing a smearing or veiling of the sound. Expressed as a percentage, the lower the number, the better.

● ips - abbreviation for inches per second, usually referring to a tape's running speed.

jack - the receptacle that accepts a plug.

● joystick - a new type of unitized control that permits balancing left, right, front, and back channels in a four-channel system.

k - abbreviation for kilo.

kHz - abbreviation for kilohertz, which are thousands of hertzes. Thus 3 kHz means 3,000 Hz.

lavalier microphone - a microphone with acoustical and vibration-isolation properties suiting it to use for speech pickup from a position on the speaker's chest. Lavalier mikes are fitted with a band or strap for hanging around the neck, and are frequently used where it is important the the mike not be conspicuously visible (to a TV audience, for example).

leader - tough, nonmagnetic tape spliced ahead of the recorded material on a tape that is expected to receive rough or frequent handling. Usually has one matte-finished surface on which to write, and often available in a variety of colors for identification.

level - the intensity of amplitude of a signal.

level indicator - a device for showing visually the level of the audio signal.

lifter - a movable rod or guide that draws the tape away from the heads during fast-forward or rewind modes, to eliminate needless head wear. Lifters work automatically on most machines in either high-speed mode.

limiter - a device that reduces the intensity of very-short-duration peaks (transcient peaks) in the audio signal without audibly affecting dynamic range.

line - the interconnection between two electrical devices. Usually used with reference to a long run of interconnecting cable, i.e. from a microphone to its tape-recorder input.

line level - based roughly on the "standardized" signal intensity sent over a telephone line, this refers to any audio signal having a maximum intensity of between ½ and 1½ volts. Typically this is the signal level put out by audio components after preamplification; also called "high level:.

loop - A length of tape with its ends spliced together to form an endless loop as in 8-track cartridges.

low-noise tape - Magnetic tape with a signal-to-noise ratio 3 to 5 dB better than conventional tapes, making it possible to record sound -- especially music with a wide frequency range -- at reduced tape speeds without incurring objectionable background noise (hiss) and with little compromise of fidelity.

low-print tape - Special magnetic recording tape significantly less susceptible to print-through (the transfer of signal from one layer of tape to another), which results when tape is stored for a long period of time.

m - Abbreviation for milli.

M - Abreviation for mega.

matching - The connection of a component's output to an input which provides the recommended value of load or "termination impedance."

mega - One million (1,000,000).

micro - One-millionth (1/1,000,000).

✓ microphone - A device for converting sound waves or sound-producing vibrations (i.e., from the strings of a guitar) into corresponding electrical impulses. Microphones may use as transducing elements crystal or ceramic chips, ribbons, moving coils, or capacitors. Different recording applications may call for different transducers as well as different directional patterns and impedances.

mil - One one-thousandth (1/1,000) of an inch. Tape thickness and stylus size are usually measured in mils.

milli - One-thousandth (1/1,000).

mixer - A device for combining two or more input signals while exercising individual control over the volume of each.

monaural - Literally, one-eared. Sometimes misused as a synonym for monophonic (single-channel).

monophonic - Single-channel sound recording and/or production.

monitor - Any device for listening incidentally to an audio signal that is primarily directed to some other purpose at that moment.

monitor head - A playback head that is separate from the record head, enabling the recordist to listen to what is coming off the tape a fraction of a second after it has been recorded. Without a monitor head, a tape must be recorded to its end and then rewound and replayed before the recordist can evaluate the tape.

NAB curve - In tape recording, response standards established by the National Association of Broadcasters to ensure complete interchangeability from one recorder to another of the same speed.

● noise - Any sounds not related to the signal and which may be introduced during recording or playback. Noise includes hiss, crackles, hum, rumblings, ticks, pops, etc.

noise suppressor - Any device intended to reduce the audibility of noise in audio work.

✓ nondirectional microphone - Same as omnidirectional microphone.

✓ omnidirectional microphone - One that responds equally well to sounds reaching it from all directions.

open reel - Same as reel to reel. Used to designate any tape format in which the running tape is wound onto a separate takeup reel, as distinguished from cartridges and cassettes where the takeup reel is either nonexistent (cartridge) or is included in the tape package (cassette).

output - The signal coming out of any audio device, or the connections through which this signal is taken from the device.

oxide - Formulation of materials that serves as the magnetizable coating on a recording tape.

● peak - The maximum instantaneous amplitude of a signal or in the output of an audio device.

● phone plug - Any plug resembling a telephone switchboard plug. Generally used on headphones and high-impedance microphones.

● phono plug - A small coaxial plug used as the industry standard (in the U.S.) for interconnections between high fidelity components; sometimes called an RCA or a pin-type plug.

playback head - Magnetic head used to pick up signals from a tape. It is often the same head used for recording, but with its circuits altered by a record/play switch which also energized the erase head. See "head."

polyester - A tough, flexible material with unusually high resistance to temperature and humidity changes and dessication with age. Used as a base material for tape.

power amplifier - An amplifier designed to operate a speaker system.

● pre-amplifier - An amplifier that boosts extremely weak signal voltages, such as those from microphones, magnetic playback heads or phonograph pickups, to a level that is usable by power amplifiers, and at the same time accomplishes the necessary equalization for industry standards.

pressure pad - A soft pad of felt or similar material that is brought into contact with the back of the tape, while playing or recording, to ensure intimate contact between the magnetic coating and the head gap.

● print-through - The transfer of magnetically recorded material to adjacent layers of tape on the reel. Print-through causes faint "echoes" preceding and following loudly recorded passages, and is aggravated by recording at excessively high levels or by exposing recorded tapes to alternating magnetic fields, as from nearby power transformers.

● quadraphonic sound - Also called quadrisonic sound and sometimes shortened to quad. Strictly, this means sounds recorded and reproduced from four different directions, to produce a field of sounds coming from an apparent 360 degrees around the listener. Generally, any system of sound reproduction using more than the two usual stereo signals to re-create an impression of sounds coming from the rear of the listener as well as from the front.

reverb - An electromechanical device for simulating room reverberation. ~~See "echo."~~

reverse - As distinguished from high-speed rewind, a reverse function allows a recorder to change head configuration and tape direction at the end of a tape so as to continue playing (or recording) on the reverse tracks without switching reels or turning over the cassette.

rewind control - Button or lever for rapidly rewinding tape from the takeup reel to the supply reel.

self-erasure - The tendency for strongly magnetized areas of the tape coating to erase adjacent areas of opposite-polarity magnetization. This is a major cause of loss of high frequencies at reduced tape speeds.

signal - Electrical energy generally; in audio, the electrical replica of intelligence.

signal-to-noise - A ratio, often abbreviated as S/N, between a device's or system's signal intensity and its accompanying noise content. In tape recording, for instance, the S/N ratio usually lies between the permissible limit of distortion due to saturation of the tape, and the background hiss of the tape and/or the recorder's circuitry. S/N is expressed in decibels; the greater the number, the better.

S/N ratio - See "signal-to-noise."

● sound-on-sound - The recording of a composite tape track by playing a previously recorded track while mixing in an additional signal.

● sound-with-sound - A special provision of some recorders that allows the record head for one channel to be used for listening to that track while adding new material in exact synchronism on the other track without the degradation of one sound caused by the dubbing step in sound-on-sound mixing.

stereophonic recording - Sound recording with depth and breadth. A stereo recording is made with two or more microphones and channels which convey information about the original lateral directions of the instruments and performers.

✓ super-cardioid microphone - A microphone having cardioid "polar pattern" with an unusually high discrimination between sounds from the front and rear.

supply reel - The "feed" reel from which the tape unwinds while playing or recording.

● tails-out - Originally, storage of a nonreversing tape on the takeup reel rather than on the supply reel to avoid the tape-distorting internal winding stresses and uneven wind of high-speed rewinding. In the case of reversing tapes, such as cassettes or four-track open-reel tapes, tails-out means storing the tape wound on whichever reel (or hub) it ends up on after having been played or recorded.

takeup reel - The reel onto which a tape is wound when playing or recording.

tensilized tape - A variety of polyester backing that has been "prestretched" to prevent further severe elongation when subjected to excessive tension. A tape that does not stretch before breaking can be spliced back together without loss of program material.

THD - Abbreviation for total harmonic distortion, including hum. Expressed as a percentage -- the lower, the better.

track - The path of magnetic signals on a tape along which a single channel of information is recorded.

track configuration - The number of separate signal tracks that a machine can play or record. Thus: a two-track machine that makes or plays two parallel tracks, each occupying slightly less than half the width of the tape, and therefore called a half-track unit. A four-track (or quarter-track) machine makes or plays four parallel tracks, two in the same playing direction on a two-channel machine or four in the same playing direction on a quadriphonic machine. Monophonic machines are said to be full-track, half-track, or quarter-track.

transport - The platform or deck of a tape recorder on which the motor (or motors), reels, heads, and controls are mounted. It includes those parts of the recorder other than the amplifier, preamplifier, loudspeaker, and case.

✓ unidirectional microphone - A microphone that is most sensitive to sounds arriving at it from one direction.

● VU - Abbreviation for "volume unit" a form of decibel reference to a standard value (1 milliwatt into a 600-ohm load).

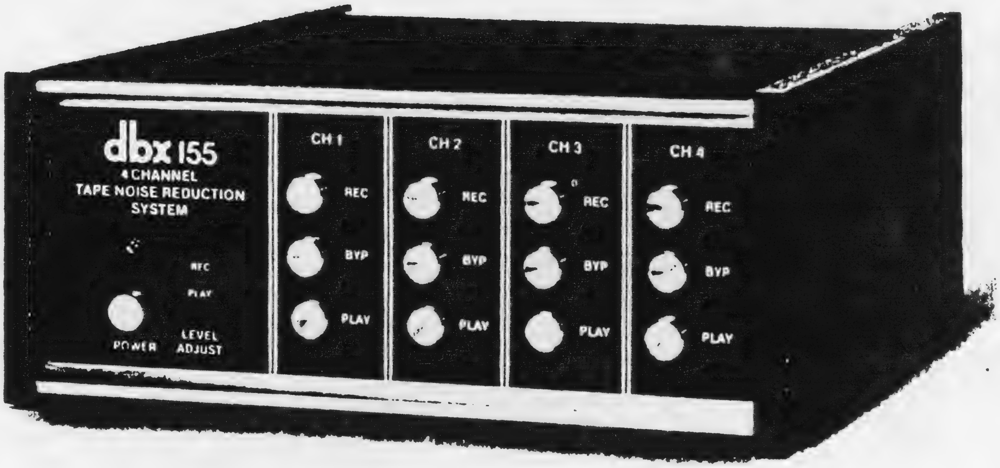
● VU meter - Strictly, a recording-level meter whose indicator needle's motion is damped according to a specified standard to allow it to respond at a certain speed to sudden impulses without overshooting the mark by more than a certain amount. The term is loosely applied to practically any record-level indicator that uses an indicator needle.

● wow - A relatively slow variation in the pitch of a reproduced signal due to similar variations in the speed of the tape or disc. Wow may be caused by erratic speed of a tape transport.

XLR connector - A shielded three-conductor microphone plug or socket with a finger-release lock to prevent accidental removal. The standard connector for professional microphone users.

ADDITIONAL TERMINOLOGY..........

dbx 155 4-channel professional format tape noise reduction system



description

The dbx Model 155 professional format tape noise reduction system is a four-channel unit which brings professional quality noise reduction to the small studio. It is fully compatible with the dbx models 152, 154, 157, 158, 177, 187, and 216 as well as TEAC/TASCAM DX-8, DX-4, and other on-board dbx pro-format tape noise reduction systems. Like its professional counterparts, it is a mirror-image compressor/expander providing in excess of 30 dB broad band tape noise reduction plus a 10 dB increase in recorder headroom. All four channels are independent and switchable (front panel) to record (encode), bypass or play (decode) functions. The 155 also has user-changeable modular circuit boards, so that in the unlikely event that one processor fails, the other channels remain operational. Spares may be ordered (order Part # 051)

In the record or encoding mode, the model 155 compresses the input signal from the console or other output circuit by a 2:1 ratio, linear in decibels over a 100-decibel range. In playback, the circuitry is switched to provide an exact complementary 1:2 expansion of the encoded signal. High frequency pre-emphasis in recording, and complementary de-emphasis in playback is applied to virtually eliminate any problems such as pumping or breathing.

Unlike competitive systems, the dbx tape noise reduction circuitry utilizes true RMS sensing, insuring proper encode/decode tracking, for accurate transient response, regardless of phase shifts in the transmission or storage (tape) medium. No time-consuming calibration procedures are required.

Utilized with today's high quality multi-track tape recorders such as TEAC, TASCAM, Otari, etc., the dbx 155 eliminates audible tape hiss, and does away with the noise build-up factor that usually accompanies "bouncing" material from track to track, and combining tracks in the mixdown process (see additive noise chart). It cannot, however, remove noise present in the original signal or program material.

application

The dbx model 155 is built to provide four independent channels of tape noise reduction for the small studio, audio-visual house, and any kind of musical organization desirous of making professional quality, noise-free recordings with a wider dynamic range and cleaner sound than would be otherwise possible. In two channel application, the 155 allows you to simultaneously monitor the decoded (normalized) signal as you record.

It can also be used to play back dbx-encoded tape recordings from professional outside sources. Its small size permits easy installation.

features

- 30 dB broad band tape noise reduction
- 10 dB added system headroom
- true RMS detection for accurate encode/decode tracking
- linear decibel compression/expansion over 100 dB range
- no pilot tones or level match adjustments necessary
- all inputs and outputs terminate in RCA phono connectors
- front panel record and play level adjust
- user changeable modular circuit boards for each channel; spares available at additional cost
- rack mount kits available to accommodate either a 155 pair or single unit

HOW dbx NOISE REDUCTION WORKS
A Short Explanation

To reduce tape noise, the dbx 155 utilizes a sophisticated version of the classical compressor/expander (compander) concept. The RECORD processor compresses the input to the tape recorder by a 2:1 ratio, linear over more than a 100dB range. Upon playback, the PLAY processor provides 1:2 expansion of the recorder's output. The expansion is a mirror image of the compression, so the retrieved audio cannot be distinguished from the original audio source, and virtually no audible tape noise has been added.

Consider a 100dB program which might have loud peaks at +18dBm and quiet passages as low as −82dBm. If the tape recorder has a maximum input level of +18dBm before distortion and a residual noise level of −50dBm—in other words, a 65dB S/N ratio typical of many good multi-track tape machines—there is no way the original program dynamics can be captured on tape; peaks will be lost due to saturation, quiet passages will be lost in the noise, or a combination of both. dbx encoding will solve this problem by compressing the 100dB program to a maximum of 50dB dynamic range. That is, the dbx encoding will bring the maximum signal level down to +9dBm and raise the minimum level to −41dBm. This is equivalent to a compression by a factor of 2, which allows the recorded program to fall within the usable dynamic range of the tape. That is, the quietest signal remains above the noise and the loudest signal remains below the point of tape distortion.

WHAT YOU SHOULD KNOW ABOUT dbx TAPE NOISE REDUCTION PROCESSING

1. dbx will not remove noise already in the program source.
2. No audible noise will be added by the recording or dubbing.
3. dbx processing can aggravate tape machine frequency response errors.
4. You need not, and should not, record above +1VU with dbx.
5. Dolby* is not compatible, or necessary with dbx processing.
6. Lie! → Each channel of a dbx encoded tape **must be** decoded independently before mixing.
7. Tape machine VU meter excursion will be less than the console's VU meter excursion because the recorder is indicating the level of a compressed signal.

Making a dbx-Encoded Tape

1. Place all 155 channels in RECORD mode for making a 4-channel tape; for stereo tapes, set only channels #1 and #2 to RECORD, and leave the other channels in PLAY mode.

NOTE: Do not change the settings of the noise reduction switches while recording since this would ruin your recording.

CAUTION: Never depress the REC and PLAY switches on one channel of the 155 simultaneously. The resulting output could damage your sound system.

2. Using an input signal that is similar in level to the program to be recorded, or using the program itself, place your tape machine in Record Ready mode (PAUSE mode) and set the machine's recording level for **maximum** VU meter readings of about 0VU. Average VU meter readings should be −2dB to −3dB for reel-to-reel recordings. These, or even lower recorded levels may be used with success because the dbx processing prevents audible tape noise.

3. Restart the program and start the tape recording. If your system is set up for off-the-tape monitoring with the Model 155, you can monitor the program in decoded form while it is being recorded by switching your preamplifier's TAPE MONITOR switch to TAPE; switching between SOURCE and TAPE gives an "A-B" comparison of original program to the dbx-processed program.

Playing Back a dbx-Encoded Tape

1. To play back a 4-channel dbx-encoded tape in decoded form, place all 155 channels in PLAY mode; for stereo dbx-encoded tapes, place only channels #3 and #4 in PLAY Mode.

2. Place the tape machine in PLAY mode, and your preamplifier's TAPE MONITOR Switch to TAPE. Play the tape normally.

NOTE: If you listen to an encoded recording without decoding, the sound will seem shrill, lacking in bass, and will vary little in loudness. Hiss, hum and other noise will fill momentary pauses in the music. The unpleasant sound of an encoded program is normal, but when decoded, the recording should sound excellent—clean, exciting music against a background of silence.

Bypass Mode

To listen to a conventional disc, or FM broadcast without dbx processing, simply set your preamplifier's TAPE MONITOR Switch to SOURCE. To play a conventional (non-encoded) tape, or to bypass the dbx processing for any other reason, place the 155's channels in BYPASS mode.

Copying a dbx-Encoded Tape

Making a dbx-encoded copy from a dbx-encoded original tape provides a copy with no more audible noise than the original.

1. Since the encoded tape does not require additional dbx noise reduction processing in order to be copied, the master machine's Play Outputs can be connected directly to the slave machine's Record Inputs.*

2. ADJUST THE RECORD LEVELS FOR **PEAKS** NO HIGHER THAN 0VU ON REEL-TO-REEL MACHINES. Ideally, the **average** VU meter readings should be −2dB to −3dB for reel-to-reel recordings.

Making a Non-Encoded Copy of a dbx-Encoded Master

Making a non-encoded copy from a dbx-encoded master is sometimes necessary so that the copy can be played where dbx tape noise reduction equipment is unavailable. The copy will be similar to an original recording made without the benefit of dbx processing: in other words, with restricted dynamic range and audible tape hiss.

The encoded master tape must be dbx-decoded prior to feeding the slave machine. This may be accomplished in a number of ways depending on the nature of your installation.

If your preamplifier, amplifier or receiver has two tape monitor loops with switching for "Dub A to B" or similar copying provisions, refer to the connections in Figure 11.

1. Place the 155's channels #1 and #2 in BYPASS mode and place channels #3 and #4 in PLAY mode.

2. Set your preampfifier to "Dub A to B" mode, set the "master" tape machine to Play mode and the "slave" machine to Record mode. Peak VU meter readings on the "slave" machine should be 0VU to −1VU.

If your preamp (or receiver) has only one tape monitor loop, there are two ways to make a non-encoded copy:

1. Either (a) disconnect the 155 PLAY OUTPUTS from the preamp's Tape Monitor Inputs, and connect the cables instead to the slave machine's Record Inputs.(Figure 12, or (b) simultaneously connect the dbx PLAY OUTPUTS to the preamp and to the slave's Record Inputs by using "Y" adapters, Figure 13.)

2. In either case (a) or (b) described in Step 1, place the 155's channels #1 and #2 in PLAY mode (for 4-channel tapes, place all channels in PLAY mode).

3. Set the "master" tape machine to Play mode and the "slave" machine to Record mode. Peak VU meter readings on the "slave" machine should be 0VU to −1VU.

Making a dbx-Encoded Copy From a Non-Encoded Tape

Making a dbx-encoded copy from a non-encoded tape is occasionally desirable. The copy will not add any audible noise. This type of copying can be done with the installation described below. (By expanding the non-encoded tape with a dbx 117, 118, 119, 3BX, or similar expander before copying, the noise can actually be reduced, as described on page 5.)

If your preamp (or receiver) has two tape monitor loops with switching for "Dub A to B" or similar copying provisions, refer to the connections in Figure 11.

1. Place 155 channels #1 and #2 in RECORD mode, and channels #3 and #4 in BYPASS mode.

2. Set the "master" tape machine to Play mode and the "slave" machine to Record mode. Peak VU meter readings on the "slave" machine should be 0VU to −1VU.

Sound-On-Sound and Overdubbing

The dbx 155 will both encode and decode simultaneously and thus allows stereo monitoring (or real time source/tape comparison) when used with three head stereo tape machines. Mixing and "sound-on-sound" are also possible. For example, sound-on-sound is made possible by placing jumper cables between the output of one or two tape recorder channels and the input of another channel or channels. In such cases, the dbx 155 can be inserted in the jumper line, decoding the recorder's play output, and re-

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**In the discussion of copying, we use the term "master machine" to refer to the tape machine with the program to be copied. We use the term "slave machine" to refer to the tape machine which is to record the program.*

encoding the combined record input.* Overdubbing of new material, mixing it with several previously encoded and recorded tracks, is also possible.

For example, suppose you wish to mix voice or additional instruments to tracks already recorded in (encoded) form on three tracks of a 4-track machine, and re-record the new mix on the fourth track. This would "open up" the first three tracks for still additional recording. (A similar procedure could be done using two stereo tape machines, mixing two previously recorded, encoded tracks from one machine with the voice, and simultaneously re-recording the program on the second stereo machine.)

1. Connect your system as shown in Figure 14.

2. Place 155 channels #1, #2 and #3 in PLAY mode, and place channel #4 in RECORD Mode.

3. The decoded signal from the 155's Channel 1, 2 and 3 PLAY OUTPUT jacks feeds three of the inputs on the mixer. Use the passive mixing circuit shown (constructed in a metal, shielded box), or use any quality commercial, line-level mixer.

4. The voice signal (or any new program to be added) feeds another mixer input (or inputs). Since microphone signals are generally low level, the microphone must be preamplified by a good quality mic preamp, which may already be built-in to the mixer, if it is a commercial type. Inexpensive, battery-powered mic preamps are available from many electronics stores and hi-fi equipment dealers.

5. The mixer output feeds the 155's Channel 4 RECORD INPUT. To balance the original and added signals as you record the tape, use the mixer's volume controls and monitor the balance at the mixer's headphone output or at your tape recorder headphone output. (You will be listening to the decoded program only if you monitor the signal at the mixer.) If necessary, add an external headphone amplifier.

6. The encoded output from the Model 155's Channel 4 RECORD OUT jack feeds the remaining track of the 4-channel tape machine.

Alternately a similar setup may be used to decode two previously recorded channels of encoded sound, mix in new material, and re-encode the mix onto two other channels of the 4-channel tape machine, or onto a separate stereo tape machine.

Another Lie!

*It is necessary to first decode dbx-encoded tracks, independently, before mixing them together. Mixing encoded tracks without first decoding them produces a program that cannot be decoded accurately.

TIME-SPACE RELATIONS IN TAPE USE

1. At 7.5 ips, how much tape would you use in one minutes time?

2. How much tape would you use in one minute at 15 ips?

3 You have 326 feet of tape, and you want to record at 7.5 ips.
How long will it take (minutes & seconds) for this tape to play?

4. You have at your disposal, 9 minutes and 20 seconds worth of music that you want to place on tape. You are recording at 15 ips. How much tape (feet & inches) will you need to accomplish this?

5. You have the following sounds -

A car starting	1	min	8	sec
Toilet flush	2	"	33	"
Dog barking	4	"	12	"
Coughing	2	"	3	"
A sneeze	0	"	14	"

Splicing all of the above sounds together from sound to sound, without any pause in between, and dubbing from one reel to another so that there are no splices showing. You have at your disposal EXACTLY 381 feet of tape with which to do this "dub". Will you have enough tape or too much tape for your project. How much will you be over (or) short?

ELECTRONIC MUSIC

SYNTHESIZER FUNCTIONS

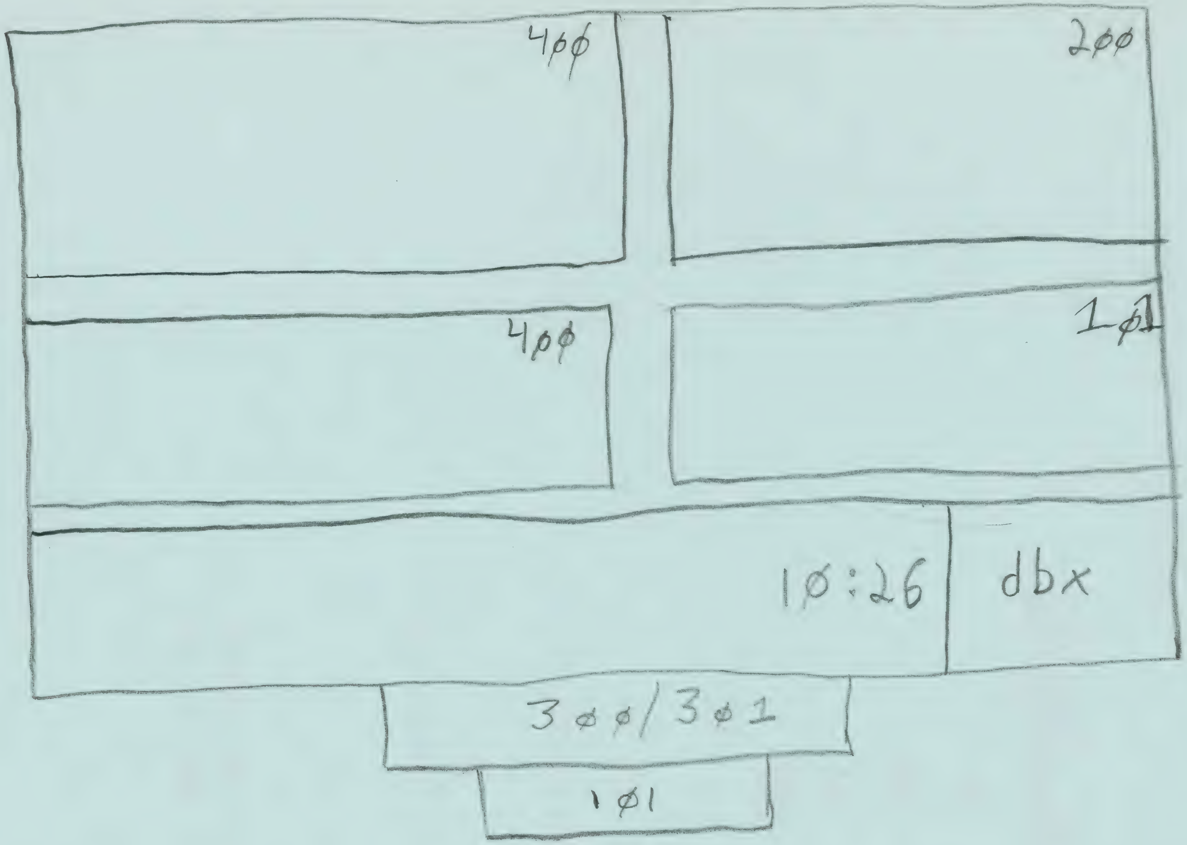
101
200
301
400

PREPARED FOR THE

ELECTRONIC MUSIC CLASSES

OF THE

AUDUBON HIGH SCHOOL
Audubon, New Jersey


10:26
dbx
300/301

BASIC FUNCTION AND OPERATION OF ANALOG ELECTRONIC MUSIC MODULES

Refer to CHAPTER IV of Textbook (*)

VOLTAGE CONTROLLED OSCILLATOR (VCO)

Provides freq's from Sub-audio through the whole Spectrum of audio.

TRIGGER Activate a signal

KEYBOARD triggers

RIBBON CONTROLLER We don't have one

(*) *Other Information concerning these Modules can be found in Chapter III*

NOISE GENERATOR Pink - high
white - med (unfiltered)
Blue - low
Unfiltered Noise

HIGH PASS FILTER passes highs

LOW PASS FILTER Passes Lows

FIXED BANDPASS FILTER Passes a band of middle freq's.

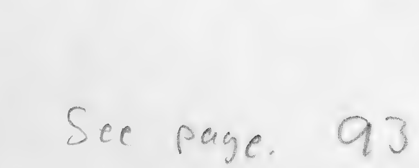
BAND REJECT FILTER Rejects a band of middle freq's.

SPRING REVERB Spring delays the signal

TIMERS, DELAY UNITS The "switch" - 200

VOLTAGE CONTROLLED AMPLIFIER (VCA) - Operates envelope

ENVELOPE GENERATOR


int. decay
sustain
attack
decay

RING MODULATION See page. 93

MIXER

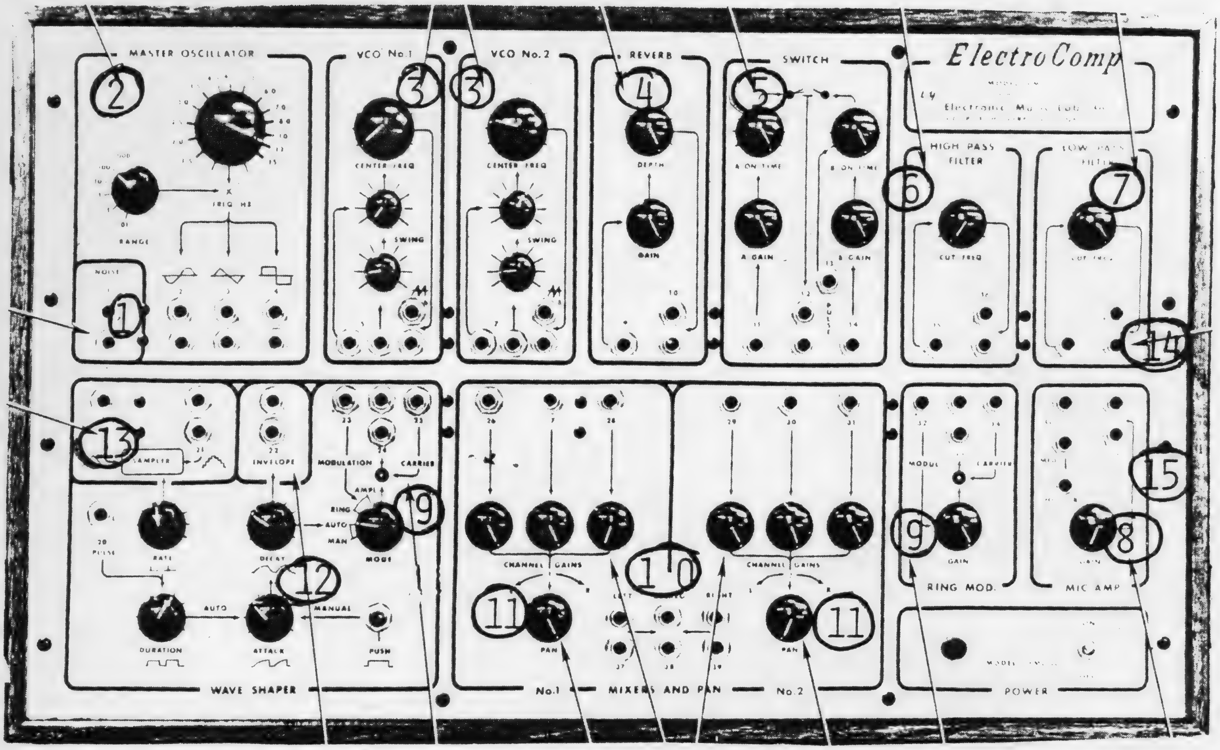
SEQUENCER (SAMPLER)

ELECTRONIC MUSIC PROCESS

SOURCE

CONTROL

MODIFIER


MASTER OSCILLATOR
VCO No.1
VCO No.2
REVERB
SWITCH
Electro Comp
HIGH PASS FILTER
LOW PASS FILTER
NOISE
RANGE
FREQ HZ
CENTER FREQ
SWING
DEPTH
GAIN
A ON TIME
B ON TIME
A GAIN
B GAIN
CUT FREQ
SAMPLER
ENVELOPE
MODULATION
CARRIER
AMPL
RING
AUTO
MAN
MODE
PULSE
RATE
DECAY
DURATION
ATTACK
MANUAL
PUSH
WAVE SHAPER
CHANNEL GAINS
LEFT
RIGHT
PAN
No.1
MIXERS AND PAN
No.2
MODUL
RING MOD.
MIC AMP
POWER
1
2
3
3
4
5
6
7
8
9
9
10
11
11
12
13
14
15

200

1. NOISE GENERATOR.

The Noise Generator is a sound source for producing wind, thunder, and percussive effects. It produces white noise which contains all the audible frequencies.

The Noise Generator can be used to produce random triggers and pitches when used in combination with the other synthesizer functions.

2. MASTER OSCILLATOR.

The Master Oscillator is a wide range, manually tunable oscillator. It produces a pitch proportional to the setting of its range switch and tuning control. Six overlapping ranges are provided covering both the audio and subaudio spectrums — .01 to 18,000 cycles per second. Three waveforms are simultaneously available — sine, triangle and square.

Only

3. VOLTAGE CONTROLLED OSCILLATORS.

~~The two Voltage Controlled Oscillators cover the audio range and produce sawtooth waveforms.~~ - Sub audio,

Each oscillator has two control inputs with attenuators. The Master Oscillator, Sampler, Envelope Generator and any of the optional keyboards may be used at these inputs to produce variations in pitch.

The Master Oscillator could be used to produce various types of vibratos of different speeds. The Sampler to generate a series of ordered or random pitches. The Envelope Generator to produce sweeping pitches. The Keyboards to produce discrete pitches of fixed interval. The pitch of the VCO's can also be adjusted manually.

4. REVERB.

The Reverb is used to delay any audio signal connected to its input. In the process it adds body and depth to the original signal. The Reverb contains a depth control for proportioning the amount of reverberated and unreverberated signal and an output attenuator for adjusting the volume. The Reverb may also be used as a waveform inverter.

5. ELECTRONIC SWITCH.

The Electronic Switch alternates two audio sound sources to a single output. The duration of each source at the output is independently adjustable and is determined by an internal variable ratio oscillator. This ratio may be varied over a 300 to 1 range. External triggers may be used in place of the internal oscillator.

6. HIGH PASS FILTER.

The High Pass Filter passes the highs and weakens the lows present in any audio source connected to its input. The cutoff frequency (where the lows start to be attenuated) is manually adjustable over a 30 to 1 range.

7. LOW PASS FILTER.

The Low Pass Filter passes the lows and weakens the highs present in any audio sound source connected to its input. The cutoff frequency is adjustable over a 30 to 1 range.

The High Pass and Low Pass filters may be combined to produce band pass or band reject filters.

8. MICROPHONE AMPLIFIER.

The Microphone Amplifier permits the introduction of external sound sources through the use of microphones and electric pickups.

9. MODULATORS.

There are two Modulators within the synthesizer. Each of them is capable of producing ring modulation. They both have a D.C. coupled input and therefore can be used in combination with the Envelope Generators to produce amplitude modulation.

10. STEREO MIXERS.

The two Mixers each have 3 inputs with volume attenuators. Through use of the Pan controls, the two mixers may be combined into a single mixer with six inputs.

11. PAN CONTROLS.

The Pan Controls permit any portion of the left mixer to be added to the right, or any portion of the right mixer to be added to the left, and therefore can be used to produce crossing effects.

12. ENVELOPE GENERATOR.

The Envelope Generator produces a waveform for shaping pitch and loudness. It may be triggered by the Sampler's internal oscillator, a manual trigger, keyboard or other oscillators.

13. SAMPLER.

The Sampler produces a waveform for generating random or ordered sequences of tones. A variable ratio oscillator is provided in the sampler for determining the sampling speed and to trigger the Sampler's associated envelope generator.

14. PATCH PANEL.

The Patch Panel provides inputs and outputs for every function contained within the synthesizer. This is particularly handy for the beginning electronic composer because it permits him to concentrate on one dimension at a time.

Output impedances are 470 ohms and are well matched for all professional equipment. All outputs are short circuit proof. For your convenience and reliability, standard size phone jacks and plugs are used throughout.

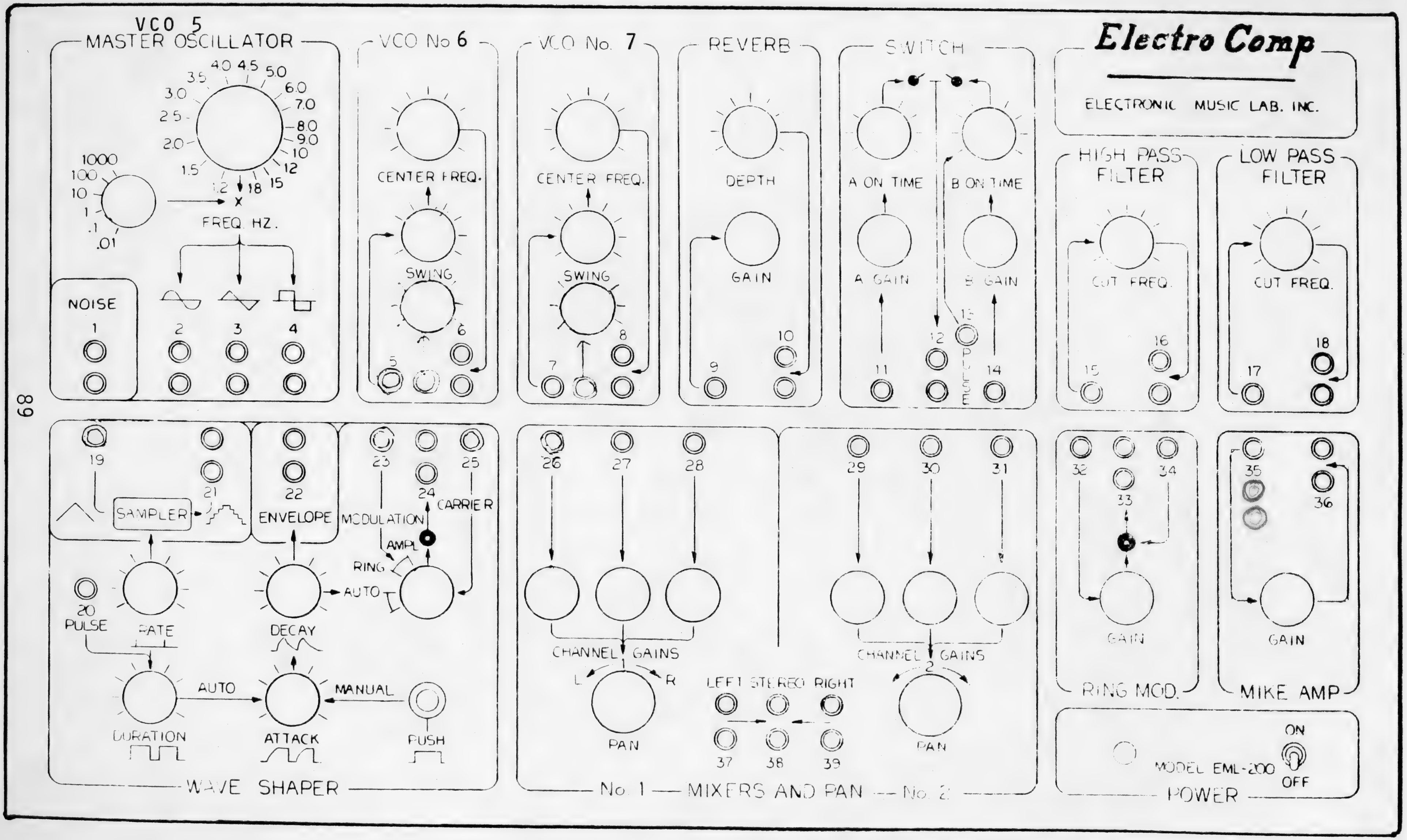
The Patch Panel also permits you to inexpensively expand your studio by adding keyboards and sequencers as your budget permits.

15. CASE.

The 200's case consists of a rugged, aluminum splined mahogany core, covered with wood-grained formica. It comes with a cover and weighs 32 pounds.

NAME ______________________ DATE __________

PROJECT ____


VCO 5
MASTER OSCILLATOR
1000
100
10
1
.1
.01
1.2
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
6.0
7.0
8.0
9.0
10
12
15
18
X
FREQ. HZ.
NOISE
1
2
3
4
VCO No 6
CENTER FREQ.
SWING
5
6
VCO No. 7
CENTER FREQ.
SWING
7
8
REVERB
DEPTH
GAIN
9
10
SWITCH
A ON TIME
B ON TIME
A GAIN
B GAIN
11
12
13
PULSE
14
Electro Comp
ELECTRONIC MUSIC LAB. INC.
HIGH PASS FILTER
CUT FREQ.
15
16
LOW PASS FILTER
CUT FREQ.
17
18
19
SAMPLER
20
PULSE
21
RATE
DURATION
22
ENVELOPE
DECAY
AUTO
ATTACK
23
24
25
MODULATION
CARRIER
AMPL
RING
AUTO
MANUAL
PUSH
WAVE SHAPER
26
27
28
CHANNEL 1 GAINS
L
R
PAN
LEFT STEREO RIGHT
37
38
39
29
30
31
CHANNEL 2 GAINS
PAN
No. 1 — MIXERS AND PAN — No. 2
32
33
34
GAIN
RING MOD.
35
36
GAIN
MIKE AMP
ON
OFF
MODEL EML-200
POWER

ELECTRONIC MUSIC I

SPECIAL TAPE PROJECTS UTILIZING THE EML 200

1. Record a "siren like" frequency modulation on TRACK ONE and slowly pan it to TRACK 3.

2. Using the sampler ~~(ordered or randomed),~~ reverbed and filtered, pan from TRACK 4 to TRACK 2.

3. Find something that you like, and record it on both the left and right channels. Pan back and forth.

THE DBX IS TO BE USED

Dub to Half Track!

PROJECT IS DUE... ______________________

200 SYNTHESIZER TAPE PROJECT

Name ______________________

F.M. LEFT TO RIGHT	25	20	15	10
MODIFIED SAMPLER R TO L	25	20	15	10
GENERAL PANNING	25	20	15	10
TAPE QUALITY - GEN. PERF.	25	20	15	10

Neat Sound

"The Sampler" (programed Sequencer)

1. 3-19
2. 21-5
3. 6-28

BASIC PROCEDURES FOR ANALOG SOUND SYNTHESIS

Refer to CHAPTER V of Textbook

FREQUENCY MODUALTION

Sub-audio wave controlling AN Audio wave.

Sub-Audio - "Modulator" ~ Controls Speed

Audio - "Carrier" ~ Controls Pitch

An Audio wave controlling another Audio wave is called a "Side band."

AMPLITUDE MODULATION

modulator - triangle or sine (subaudio) in the ring modulator

TIMBRE MODULATION

Ring -

modulator subaudio (Pulse!)
Carrier [illegible]

ElectroComp 101

SPECIFICATIONS

1. KEYBOARD.

The 101 uses a 44 note, two-voice polyphonic keyboard. Any two keys may be played at once and up to a four note chord produced.

The keyboard has variable tuning and may be transposed up to four octaves. The keyboard interval may be adjusted to microtonal scales. Variable portamento permits gliding between tones.

2. KEYBOARD CONTROLLER.

The keyboard controller is used to set the interval and the amount of portamento. The interval is adjustable from 12 to 72 keys per octave. Portamento is adjustable from 0 to 1 second per octave. Portamento may also be controlled from foot pedal.

3. FOUR OSCILLATORS.

The 101 contains four voltage controlled oscillators which offer six waveforms: triangle, square, sawtooth, inverted sawtooth, pulse and sloped square. Three oscillators have continuously adjustable waveforms.

The oscillator frequency is controlled by the keyboard and selected inputs of the oscillator control. All four oscillators operate in the audio range; two cover the audio/subaudio ranges. The output frequency range is from .03 to 20,000 Hz. The sampler contains a fifth oscillator. Its output frequency range is from .2 to 40 Hz.

OSCILLATOR STABILITY. The 101 has the most stable synthesizer oscillators. Their stability is due to a proprietary circuit that maintains the oscillators at a constant temperature. Short term variations in pitch are typically less than ±0.1%.

4. OSCILLATOR CONTROL.

The oscillator control determines the type and amount of variation in pitch. The variations may be of the following varieties:

a. Envelope selection produces slow or rapid sweeps up and down in pitch with each key depression. The type of sweep is dependent on the settings of the envelope's attack, decay, and sustain controls.

b. Oscillator selection produces repeating changes in pitch. The type of change is determined by the oscillator waveform selected. The speed of change is determined by the frequency of the selected oscillator. The wide range of the oscillators permits anything from slow vibratos to audio speed frequency modulation.

5. NOISE GENERATOR.

The noise generator is a sound source used for producing wind, thunder, and percussive effects.

6. FILTER INPUT MIXER.

The filter input mixer contains volume controls for three oscillators and the noise generator. The volume controls are used for selecting and proportioning sound sources to the filter. An input is available for adding external or other internal signals. This mixer may be used as a waveform inverter.

7. FILTER.

The 101's filter represents a major breakthrough in synthesizer design. It is the only multi-mode voltage controlled filter available on any synthesizer priced under $3000. This means the 101's filter is continuously variable from low pass to band pass to high pass. All competing synthesizers are limited to low pass operation. This difference provides the 101 with an enormous edge in the control of timbre.

8. FILTER CONTROL.

The filter control determines the amount and type of variations in timbre. Its function is analogous to the oscillator control. The variations are of the following varieties:

a. Envelope selection produces slow or rapid sweeps up or down in timbre.

b. Oscillator selection produces repeating changes in timbre.

c. Sampler selection produces sequential or random changes in timbre.

d. The filter control provides for continuously variable tracking. Timbre can become duller, brighter or remain constant with increasing pitch.

e. The filter can be controlled from the lowest or highest key depressed. This permits the control of pitch with one key and timbre with a second key.

f. The filter control has provisions for patching in external signals for controlling timbre.

g. These effects may be combined to produce more complex variations.

9. VARIABLE MODULATOR.

The 101's modulator is a synthesizer first. It is the only modulator that can be adjusted to any percentage of amplituce modulation or to ring modulation.

The modulator is normally controlled by oscillator 4. The wide range of oscillator 4 permits extremely slow tremolos, banjo-like strumming, or eerie ring modulation. An external input permits the replacing of oscillator 4 with external signals.

10. TWO ENVELOPE GENERATORS.

The envelope generators produce waveforms used to shape pitch, timbre, and loudness. Their shape can be precisely set with the attack, decay, and sustain controls. An external trigger is available.

11. AMPLITUDE SHAPER.

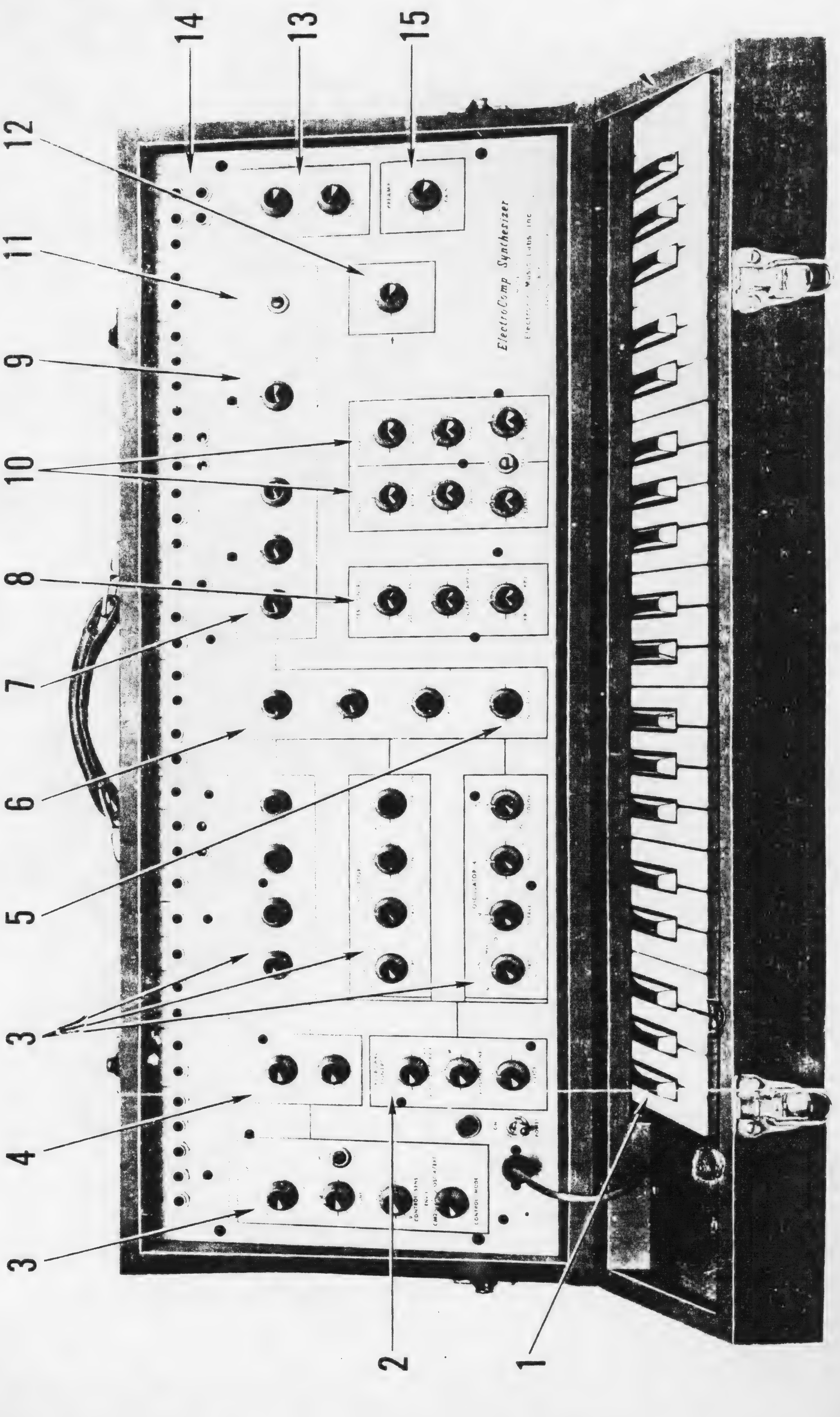
The amplitude shaper is a voltage controlled amplifier. In combination with the envelope generators it is used to shape the loudness of each tone. Either envelope may be selected.

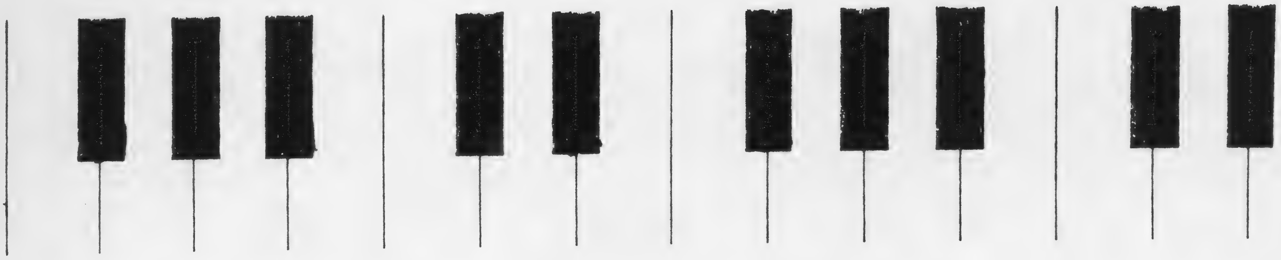
12. SAMPLE AND HOLD.

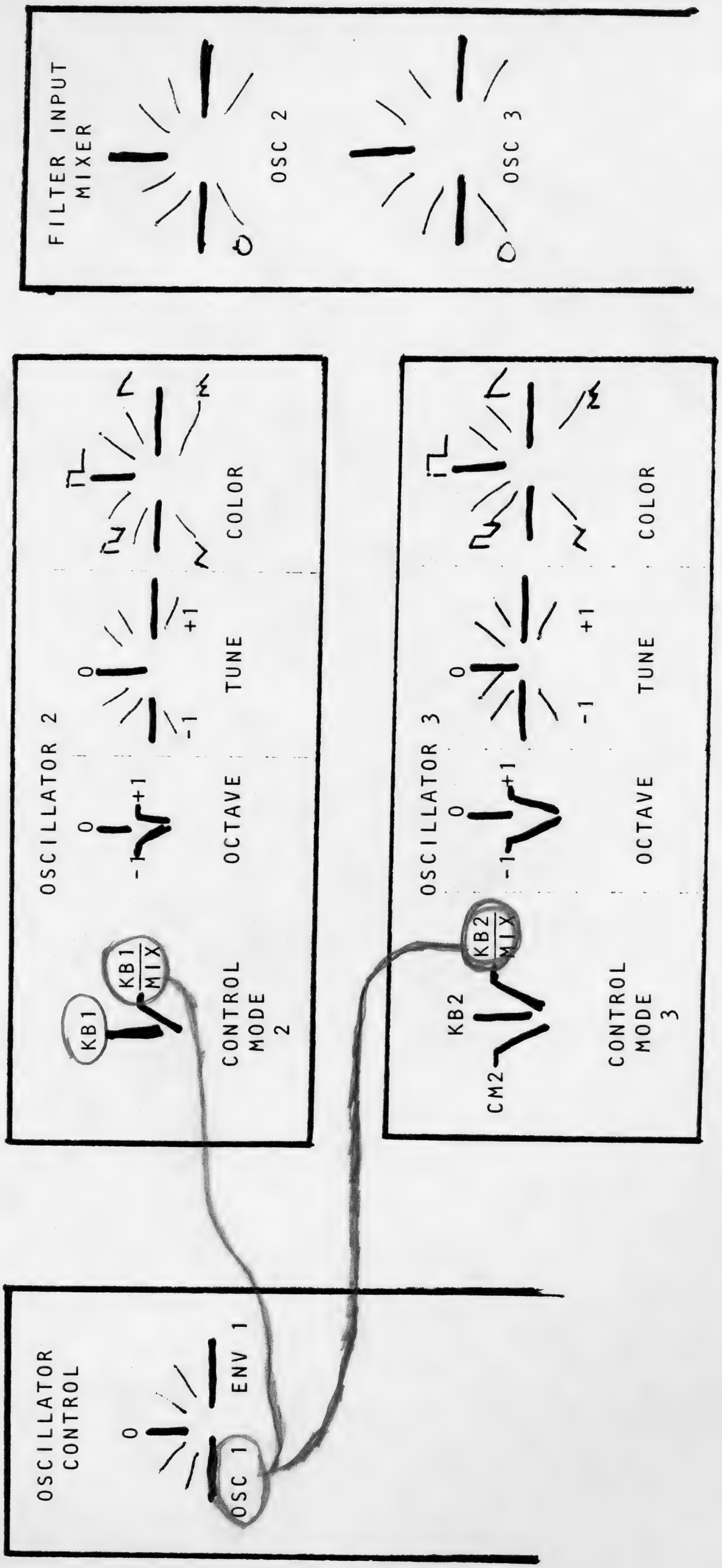
The sample and hold generates a waveform used to produce random or ordered sequences of tones, spontaneous changes in timbre or to control the entire synthesizer in place of the keyboard. An oscillator is provided in the sampler for determining the sampling speed. Its range is from 0.2 to 40 Hz. Provision for external speed control of the sampler has also been provided.

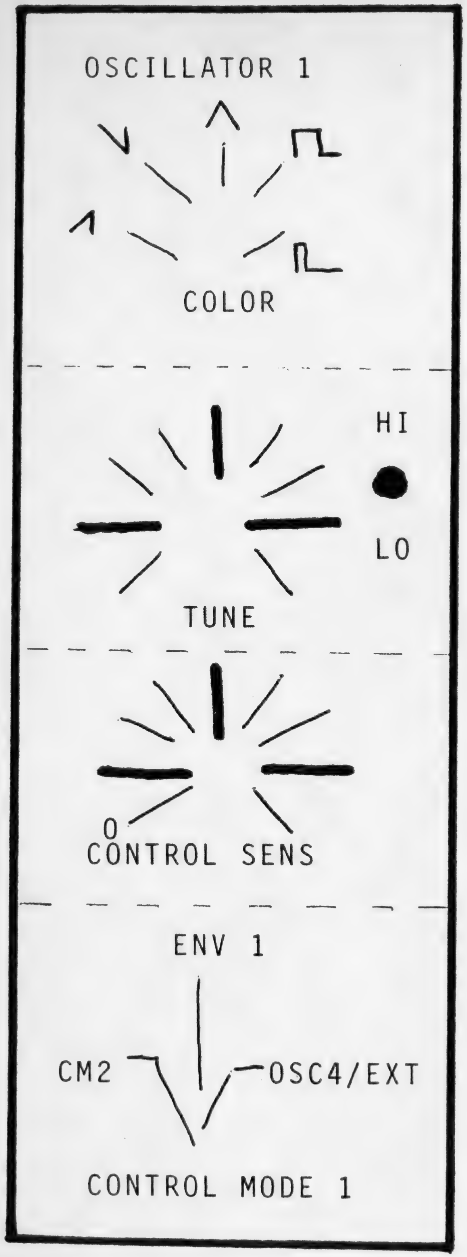
13. OUTPUT MIXER.

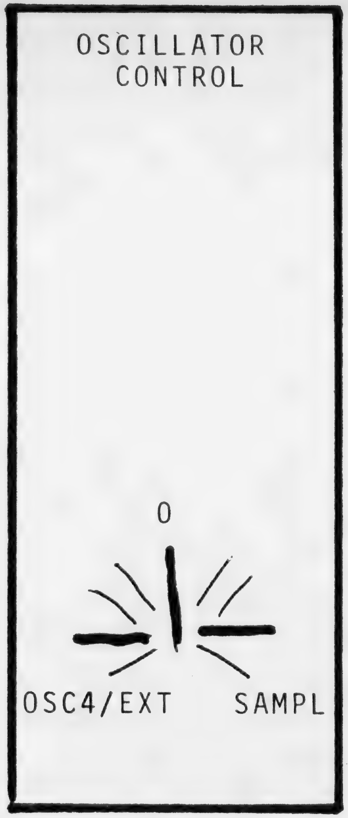
The output mixer permits the proportioning of the amplitude shaper and other internal and external signals. It may also be used as a waveform inverter.

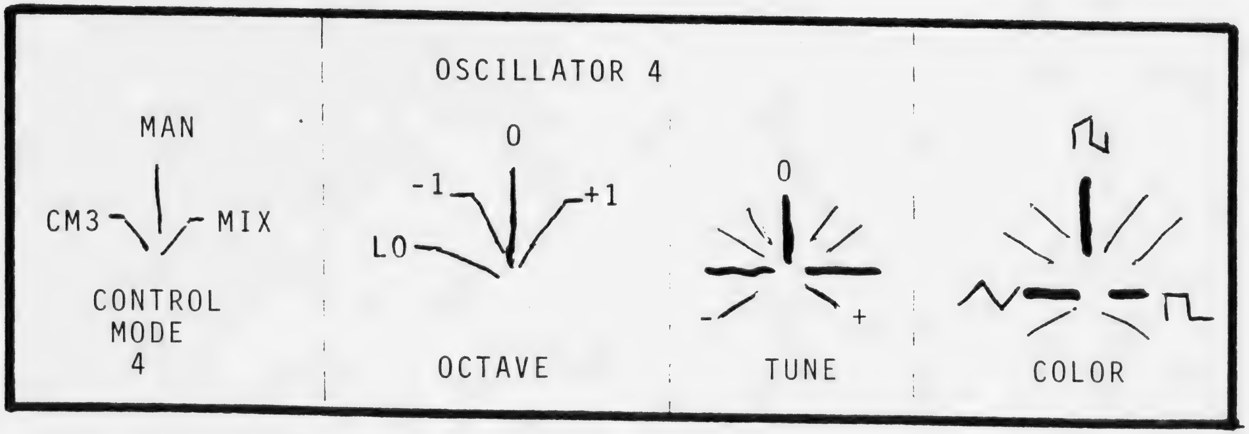

3
4
3
5
6
7
8
9
10
11
12
14
13
15
2
1
ElectroComp Synthesizer
PREAMP
CONTROL MODE

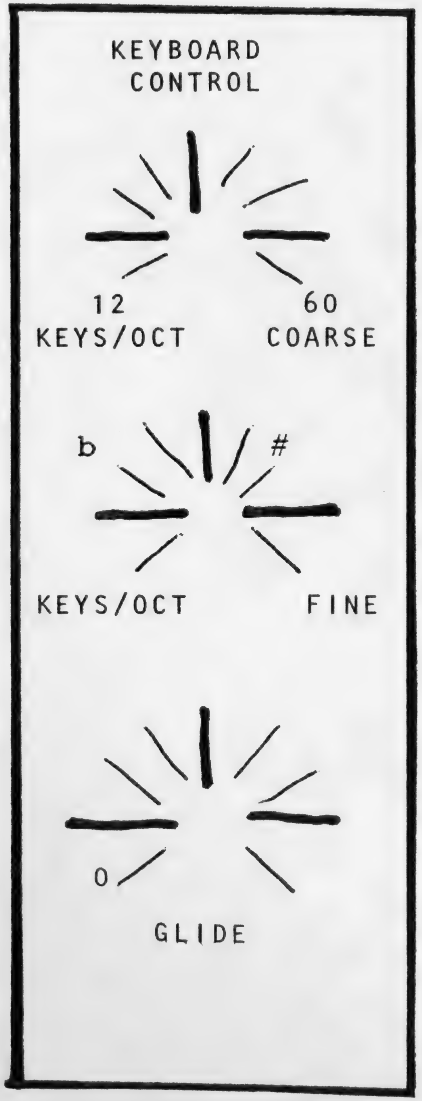


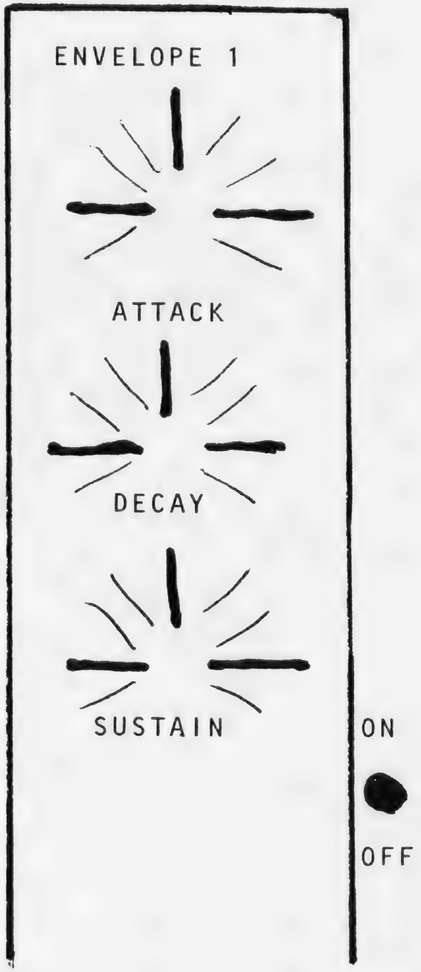

FILTER INPUT MIXER
0
OSC 2
0
OSC 3
OSCILLATOR 2
KB1
KB1/MIX
CONTROL MODE 2
-1
0
+1
OCTAVE
-1
0
+1
TUNE
COLOR
OSCILLATOR 3
CM2
KB2
KB2/MIX
CONTROL MODE 3
-1
0
+1
OCTAVE
-1
0
+1
TUNE
COLOR
OSCILLATOR CONTROL
0
OSC 1
ENV 1

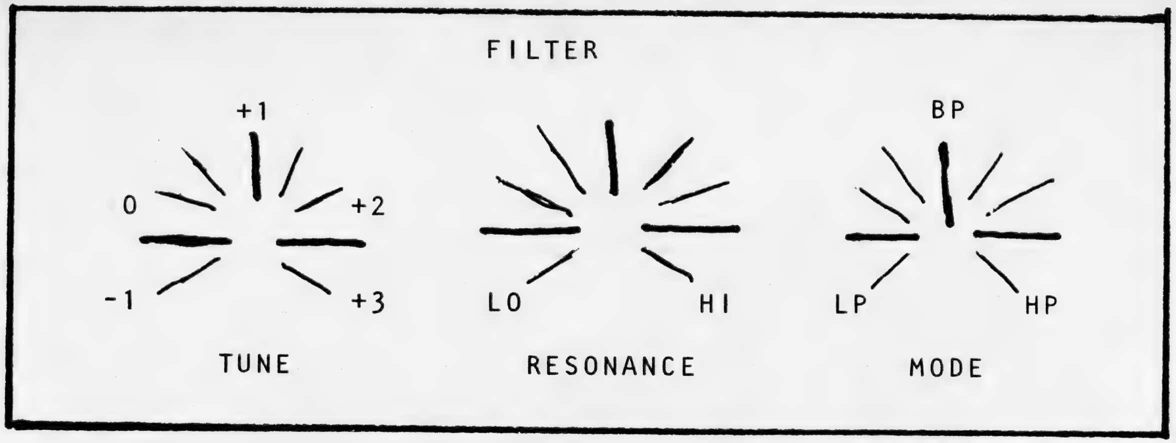

OSCILLATOR 1
COLOR
HI
LO
TUNE
0
CONTROL SENS
ENV 1
CM2
OSC4/EXT
CONTROL MODE 1

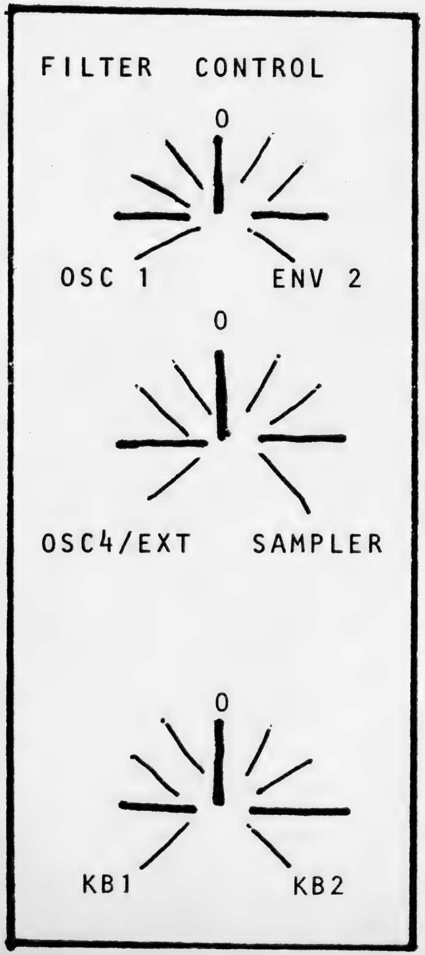

OSCILLATOR CONTROL
0
OSC4/EXT
SAMPL


OSCILLATOR 4
MAN
CM3
MIX
CONTROL MODE 4
0
-1
+1
LO
OCTAVE
0
-
+
TUNE
COLOR


KEYBOARD
CONTROL
12
KEYS/OCT
60
COARSE
b
#
KEYS/OCT
FINE
0
GLIDE


ENVELOPE 1
ATTACK
DECAY
SUSTAIN
ON
OFF

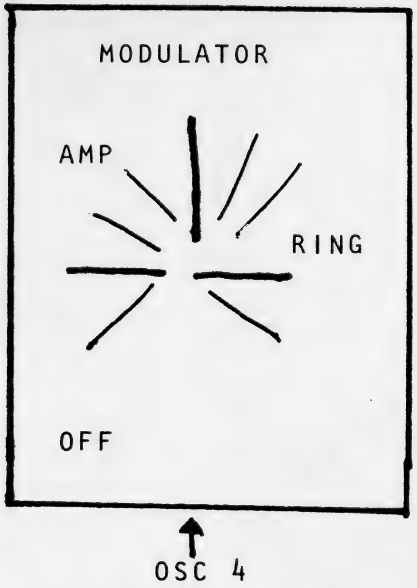

FILTER
+1
0
+2
-1
+3
TUNE
LO
HI
RESONANCE
BP
LP
HP
MODE

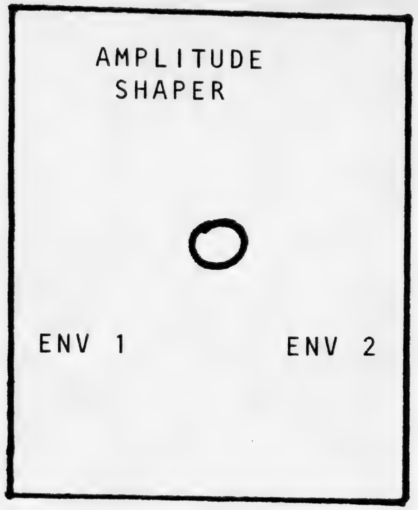

FILTER CONTROL
0
OSC 1
ENV 2
0
OSC4/EXT
SAMPLER
0
KB1
KB2

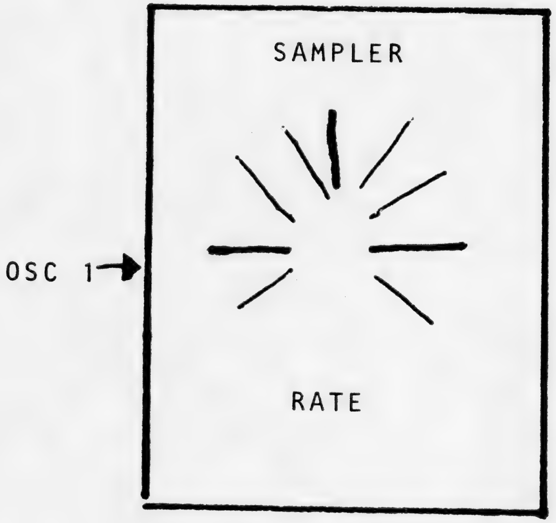
TUNE - Determines where the filter begins passing and rejecting overtones, or for that matter any pitches put into it.

RESONANCE - Determines how much the overtones near the filter's tune frequency will be strengthened. Also determines the width of the band pass.

MODE - Determines what happens to the overtones above, below or around the filter's frequency.


MODULATOR
AMP
RING
OFF
OSC 4


AMPLITUDE
SHAPER
ENV 1
ENV 2


SAMPLER
OSC 1
RATE

Rec.

ELECTRONIC MUSIC I

SPECIAL TAPE PROJECT UTILIZING THE EML 101

1. By triggering the keyboard, record a TIMBRE MODULATION on Track 1 of TD 1 and slowly pan it to Track 4. (5 seconds).

2. On Track 2, record NOISE and timbre modulate it. (5 seconds) short envelope.

3. On Track 3, timbre modulate each signal of the SAMPLER. (Medium rate, 5 seconds).

Each of the above events will follow one after the other

REDUCE YOUR TAPE TO HALF TRACK
RETURN IT TO TAPE DECK ONE

4. Using tracks _______ and _________, slowly pan a long signal (envelope) of at least two notes which will have a slight frequency modulation which is also reverbed slightly(15 seconds)

DO NOT REDUCE TO HALF TRACK

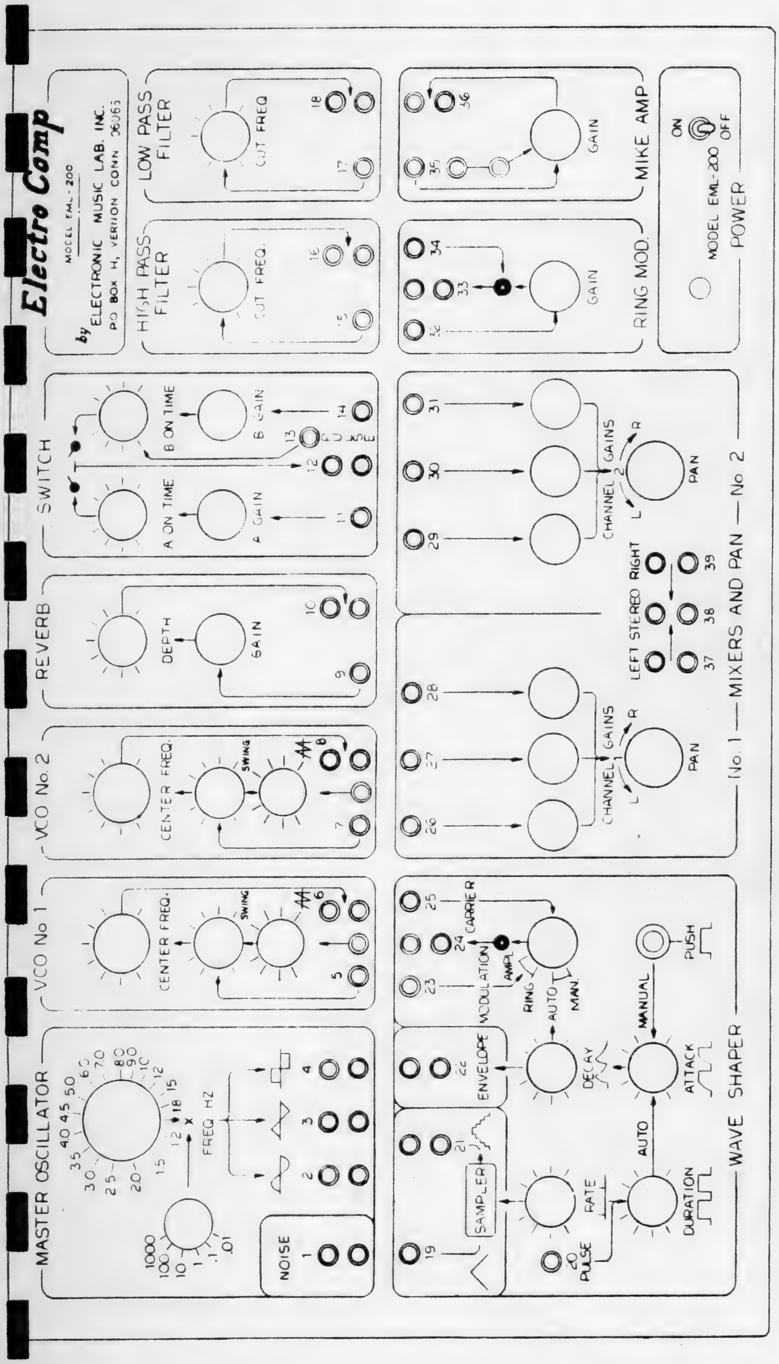
GENERAL INSTRUCTIONS:

1. Use CLEAN Scotch 207 tape. Use your own reel, and have leader tape fore and aft.
2. The dbx is to be used on all recording and playback functions.
3. Do not abruptly end the signals on your project. Fade in and out
4. When you are finished all six tracks, mark down the correct OUTPUT setting on the mixer so that all sounds are equal in amplitude.

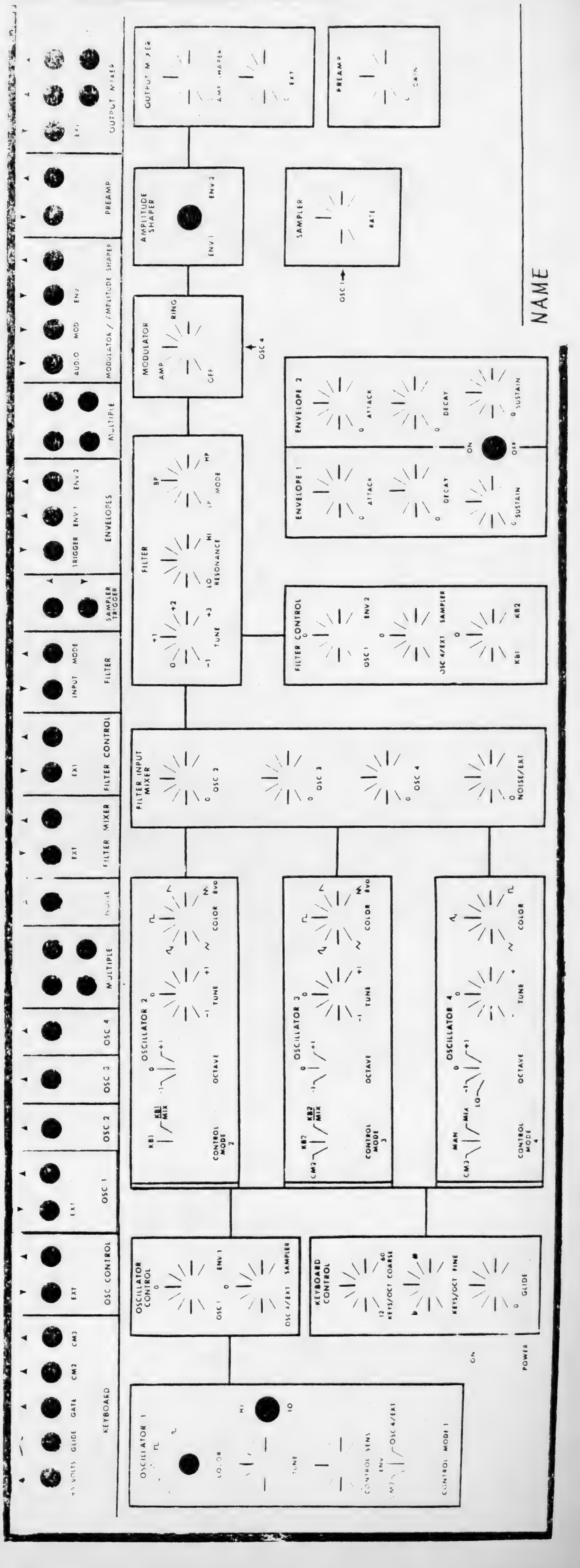
PROJECT IS DUE....________________________

ELECTRONIC MUSIC LAB

AUDUBON HIGH SCHOOL



Electro Comp
MODEL EML-200
by ELECTRONIC MUSIC LAB. INC.
PO BOX H, VERNON CONN. 06066
HIGH PASS FILTER
LOW PASS FILTER
CUT FREQ.
MIKE AMP
RING MOD.
GAIN
MODEL EML-200
POWER
ON
OFF
SWITCH
A ON TIME
B ON TIME
A GAIN
B GAIN
REVERB
DEPTH
GAIN
VCO No. 2
VCO No 1
CENTER FREQ.
SWING
MASTER OSCILLATOR
FREQ HZ
NOISE
MIXERS AND PAN
No. 1
No. 2
CHANNEL
GAINS
PAN
LEFT STEREO RIGHT
WAVE SHAPER
SAMPLER
ENVELOPE
MODULATION
CARRIER
RING
AUTO
MAN
AMP
MANUAL
PUSH
DECAY
ATTACK
RATE
PULSE
DURATION



KEYBOARD
OSC CONTROL
OSC 1
OSC 2
OSC 3
OSC 4
MULTIPLE
NOISE
FILTER MIXER
FILTER CONTROL
FILTER
SAMPLER TRIGGER
ENVELOPES
MODULATOR / AMPLITUDE SHAPER
PREAMP
OUTPUT MIXER
OSCILLATOR 1
OSCILLATOR 2
OSCILLATOR 3
OSCILLATOR 4
OSCILLATOR CONTROL
KEYBOARD CONTROL
FILTER INPUT MIXER
FILTER
FILTER CONTROL
ENVELOPE 1
ENVELOPE 2
MODULATOR
AMPLITUDE SHAPER
SAMPLER
PREAMP
OUTPUT MIXER
TUNE
OCTAVE
COLOR
CONTROL MODE
ATTACK
DECAY
SUSTAIN
RESONANCE
MODE
GLIDE
POWER
NAME

PANEL JACKS EML 101
(Listed from left to right)

(Arrows down - inputs; arrows up - outputs)

KEYBOARD

± VOLTS (output) - Constant voltage source; stereo output, +10 V, -10 V, nominal.

Glide (input) - Used with optional 101 foot switch for turning glide on and off.

Gate (output) - A voltage source of approximately 15 volts which is "turned on" for every key depression. When a key is depressed, the GATE VOLTAGE immediately goes to +15 V and will remain at that level for as long as the key is "down".

The GATE may be used to initiate envelopes of the 101, "step" a Sampler, initiate external add-on control functions (Envelope, Sampler, Sequencer) of the EML 200, EML 401 module, and EML 400 Series Sequencer.

CM 2 (output) - Keyboard 1 control voltage
Lowest key - 4.4 volts (±10%)
Highest key - 8.8 volts (±10%)

Sequencer (input) - EML 400 Series Sequencer quantized, exponential, or linear voltage input for pitch control of Oscillators 3 and 4. Oscillator 3 must be in the KB2 mode, Oscillator 4 in CM3 mode.

OSCILLATOR CONTROL MIXER

External (input) - Used to introduce external control voltage sources into the oscillator control mixer. Patching an external control source into EXT, negates the presence of Oscillator 4 in this mixer. Oscillator 4 being replaced by the new control source. Turning the lower "pot" counterclockwise determines "how much" of the new control source signal will be in the mixer.

Output - The mix of control voltages is outputted at this jack. If the "pots" in the MIXER block are both set to zero nothing will be outputted. (i.e. If the uppermost "pot" is set to 9 o'clock and the lower "pot" set to 2 o'clock, the proportional mix of the control voltages from Oscillator 1 and Sampler will be present at the output.)

OSCILLATOR 1

External (input) - Used to introduce external control voltage sources to control the frequency-pitch of Osc. 1. CM1 of Osc. 1 must be in the Osc. 4/Ext position for an external voltage to affect Osc. 1. Osc. 4 will be negated and replaced by the new control signal. The control sensitivity "pot" will determine "how much" the new control signal will affect Osc. 1.

Output - Output of Oscillator 1 allows it to be used as a source oscillator (CM2 position of the CM1 switch) by patching it into the Filter Input Mixer Ext. jack; or as a control oscillator by patching it to external control voltage inputs located throughout the audio path of the EML 101.

OSCILLATOR 2

Output - Oscillator 2 can be outputted from this point to be used as a control oscillator or to bypass the filter and/or modulator/amplitude shaper. (Voltage Controlled Amplifier)

OSCILLATOR 3

Output - (Same as Osc. 2.)

OSCILLATOR 4

Output - (Same as Oscillators 2 and 3.)

MULTIPLE (Input and/or Output) - Passive Mixer - Used to "multiply" a signal or signals. (i.e. inputting one signal into the MULTIPLE provides three outputs of the same signal.)

NOISE

(Output) - White Noise Source.

FILTER INPUT MIXER- An external input for bringing a signal into the Filter Input Mixer which introduces a mixed signal to the voltage controlled filter. Patching a signal into the Ext. jack negates Noise at the "pot" marked Noise/Ext., the "pot" will then control the volume of the external signal in the mix.

Output - The mix set in the Filter Input Mixer is available at this output for use as desired.

FILTER CONTROL MIXER

External (Input) - Same as the Oscillator Control Mixer.

Output - Same as the output of Oscillator Control Mixer, only in addition, to Osc. 1, Env. 2, Osc. 4/Ext, and the Sampler Control voltages; the logized KB1 control voltage or logized KB2 control voltage can also be placed in the mix.

FILTER (input) - Inputting an external signal into the Filter blocks the signal from the Filter Input Mixer. The external signal inputted will be the only signal filtered.

(output) - The output of the filtered (modified) signal.

SAMPLER TRIGGER

(input) - External trigger input for "stepping" (voltage controlling) the Sampler oscillator once for every trigger pulse.

(output) - Output of the Sampler oscillator. The Sampler oscillator produces a pulse waveshape and its frequency range is .2Hz to 40 Hz.

ENVELOPES

Trigger (input) - Inputting a proper trigger source (sub-audio oscillator, keyboard gate, sampler trigger out, etc.) will initiate Envelope 2. There is a "level detector" on the input of the Envelope Trigger which allows you to delay initiating Envelope 2, by inputting a voltage that increases over time, when the "trigger level" is reached, Env. 2 will start.

ENV. 1 (output) - Voltage output of the Envelope 1. The characteristics of the voltage are determined by the attack, decay, and sustain controls of Envelope 1.

ENV. 2 (output) - Same as Envelope 1.

MODULATOR/AMPLITUDE SHAPER

AUDIO (input) - Introduction of audio signals directly into the Modulator/Amplitude Shaper without Filter modification. Inputting a signal into this jack blocks the signal flow from the Filter into the Modulator/Amplitude Shaper.

MOD. (input) - This input is implemented when another modulation signal is desired other than Oscillator 4. Inputting a signal here negates Oscillator 4 as the modulation signal.

ENV. (input) - An external voltage may be used as an "envelope" to control the voltage control amplifier (amplitude shaper).

OUTPUT (output) - Output of the modulated/amplitude shaped signal.

PREAMP (input) - Used to boost low level external signals to an adequate, workable level.

(output) - Output of the boosted external signal, may be taken from this point and inputted to the Filter or Modulator for modification.

OUTPUT MIXER

EXT. (Input) - Input for external signal. Volume is controlled by EXT "pot" in Output Mixer section.

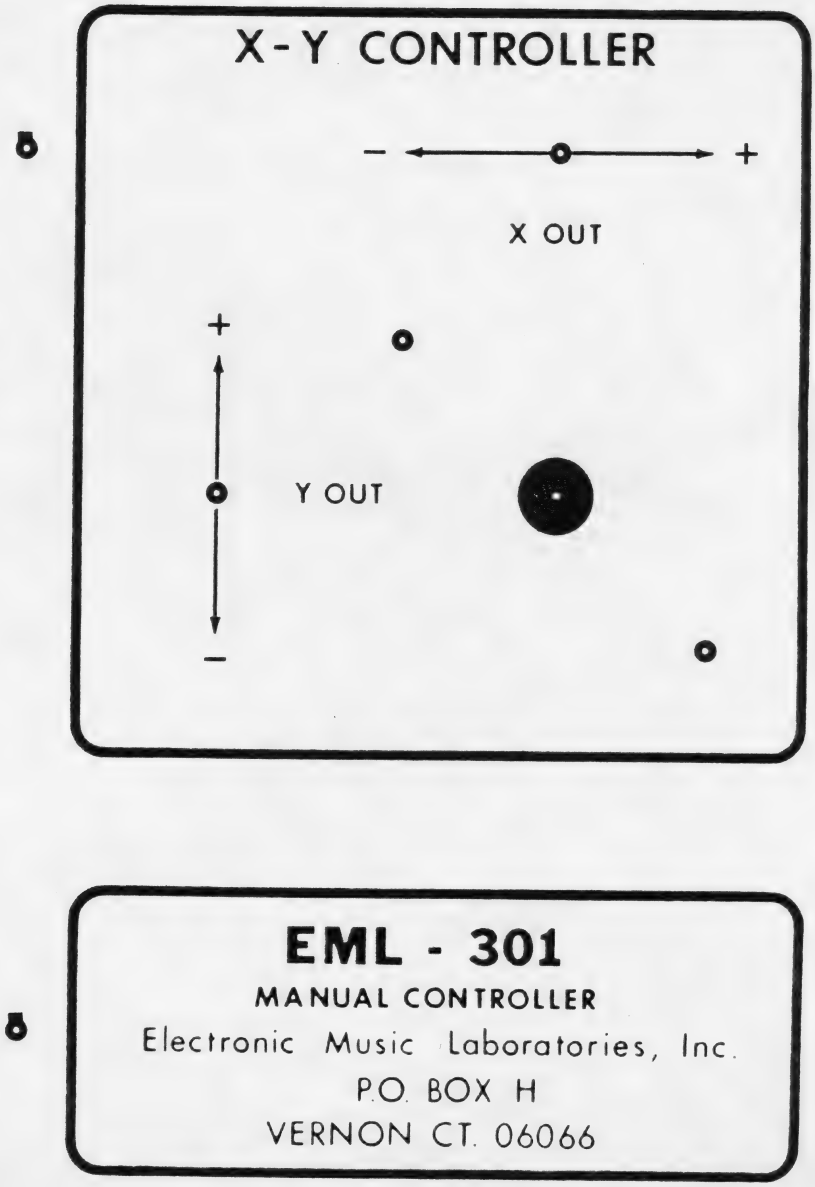
HI (Output) - High level outputs used for connecting synthesizer to hi-fi stereo type amplifiers.

LO (Output) - Low level output for connecting synthesizer to guitar type amplifier.

BASIC SYNTHESIZER TECHNIQUES

Be able to do ALL of the following:

1. Be able to create any of the 4 basic sound waves.
2. Control VCO 3 with VCO 2 and create two seperate signals
3. Create a "vibrato" effect on one applicable VCO.
4. Create a "beat".
5. Be able to produce any aspect (as given) of an envelope.
6. Be able to move any given frequency up or down 5 octaves.
7. Set any given signal so that its frequency is set to match the note "C" at 264 Hz.
8. Be able to create a frequency modulation using VCO 1 and 5 as the modulator.
9. Be able to match pitches from any combination of 2 VCO's.
10. Be able to produce TWO sub-audio waves, pulsating at the same time.
11. Be able to create "sidebands".
12. Be able to move in octaves on the keyboard.
13. Create two seperate sounds on one signal so that the top will increase in frequency while the bottom decreases in frequncy - both at the same time.


X-Y CONTROLLER
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X OUT
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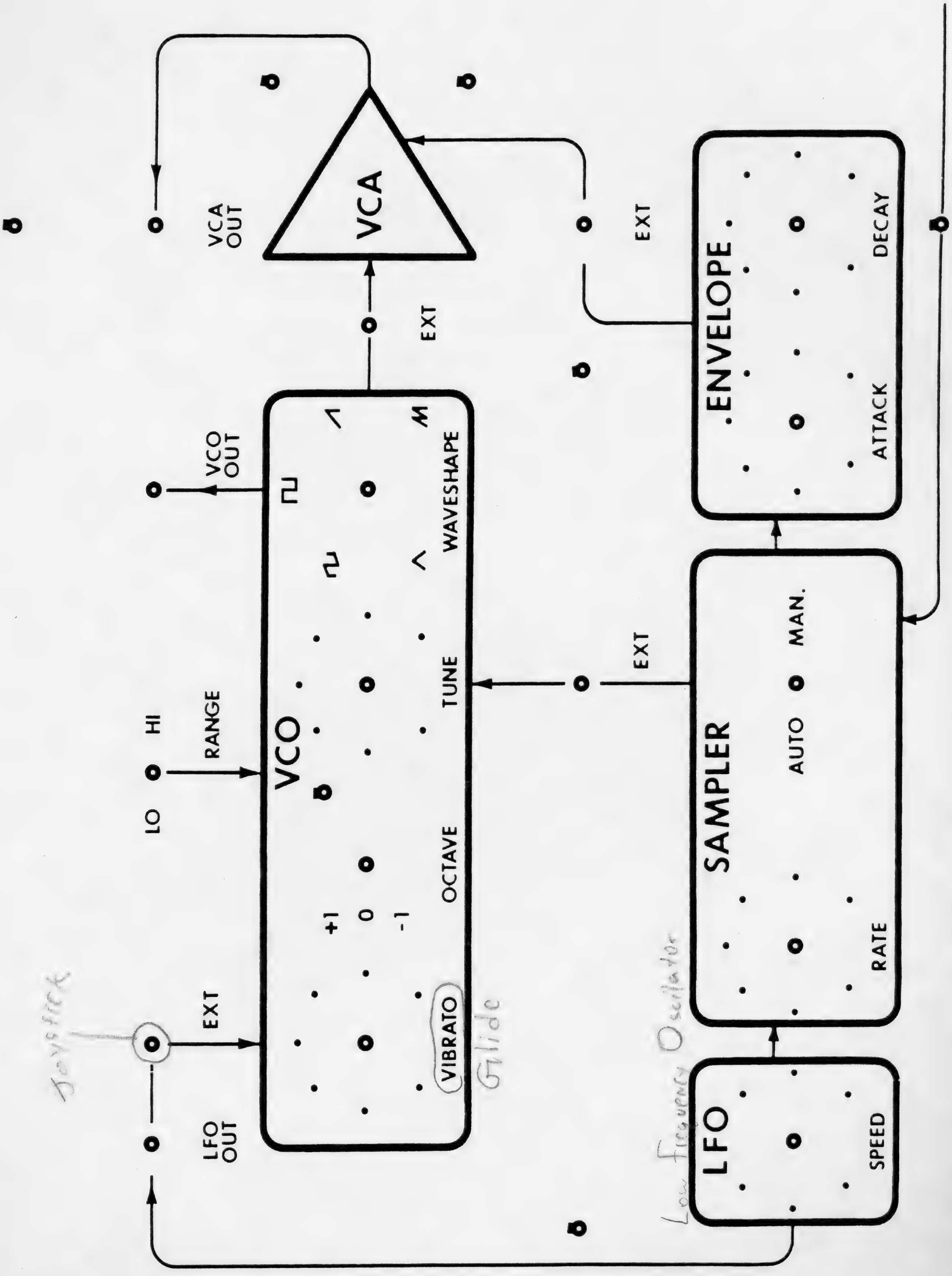
EML - 301
MANUAL CONTROLLER
Electronic Music Laboratories, Inc.
P.O. BOX H
VERNON CT. 06066


LFO OUT
EXT
Joystick
VIBRATO
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+1
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VCO
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WAVESHAPE
VCO OUT
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ENVELOPE
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SAMPLER
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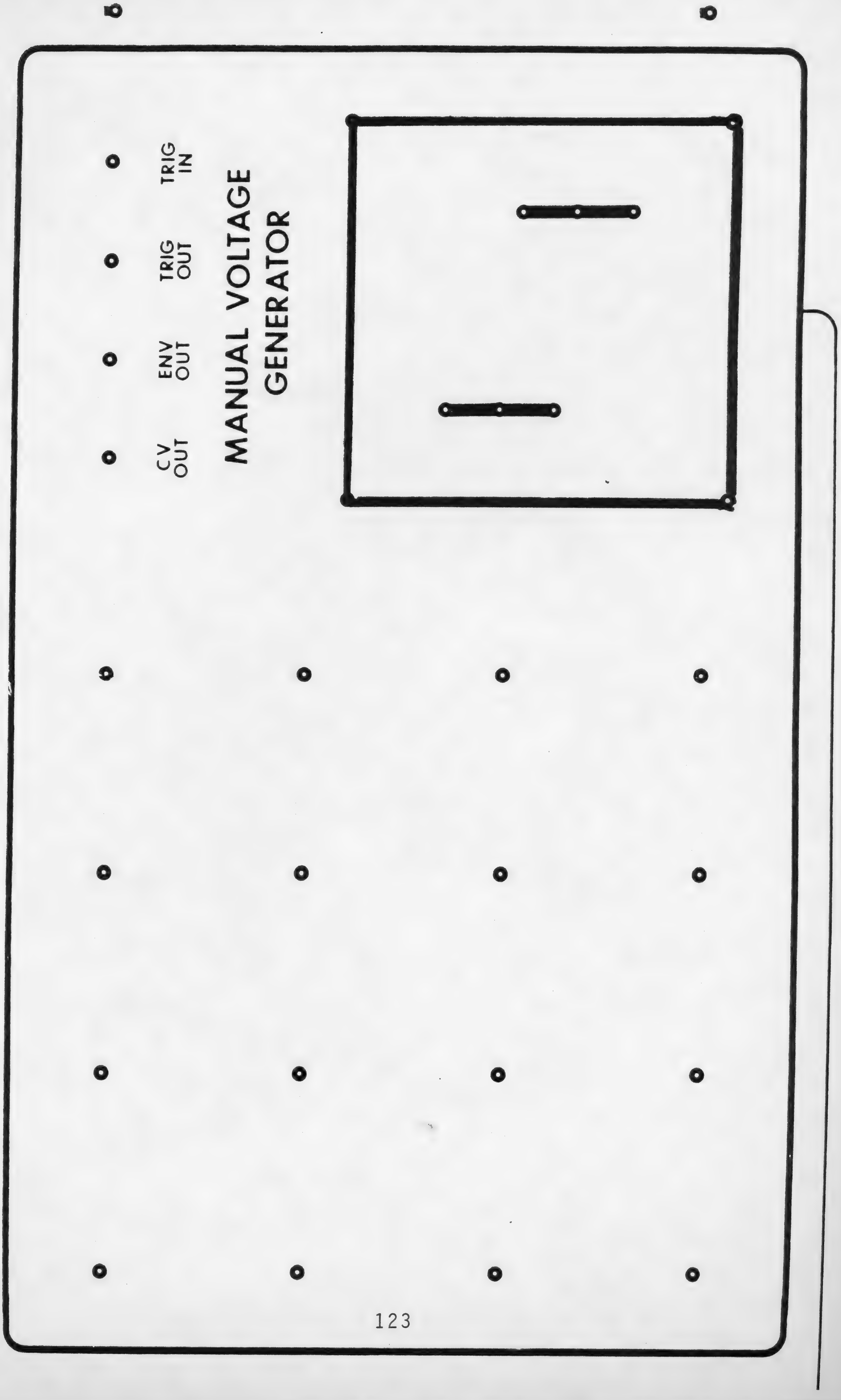
Low Frequency Oscillator



MANUAL VOLTAGE GENERATOR
CV OUT
ENV OUT
TRIG OUT
TRIG IN

ELECTRONIC MUSIC

COMPOSITION PROJECTS AND TECHNIQUES

PREPARED FOR THE

ELECTRONIC MUSIC CLASSES

OF THE

AUDUBON HIGH SCHOOL
Audubon, New Jersey

TECHNO-DWEEB

ELECTRONIC PIONEERS

BY JOHN C. PAULSON

Who are the leaders in electronic music today? What has been happening in this medium since the initial excitement in the 1950s? Now that electronic equipment is so portable and inexpensive that composers can use it in home studios, how is electronic music faring?

In 1976 I interviewed some of the world's leading electronic music composers and asked them about the possible future of electronic music. The composers I spoke with included Vladimir Ussachevsky, Milton Babbitt, Mario Davidovsky, Pril Smiley, and Otto Luening. In 1987 I recontacted Ussachevsky, Babbitt, and Davidovsky, and also spoke with Russell Pinkston, for an update on recent activities in electronic musical composition. Out of the diversity of their comments at least one conclusion can be drawn: technological advances are opening up electronic composition to far more composers than ever before. As with any development, there are benefits and drawbacks, and the composers interviewed here had strong opinions about both sides.

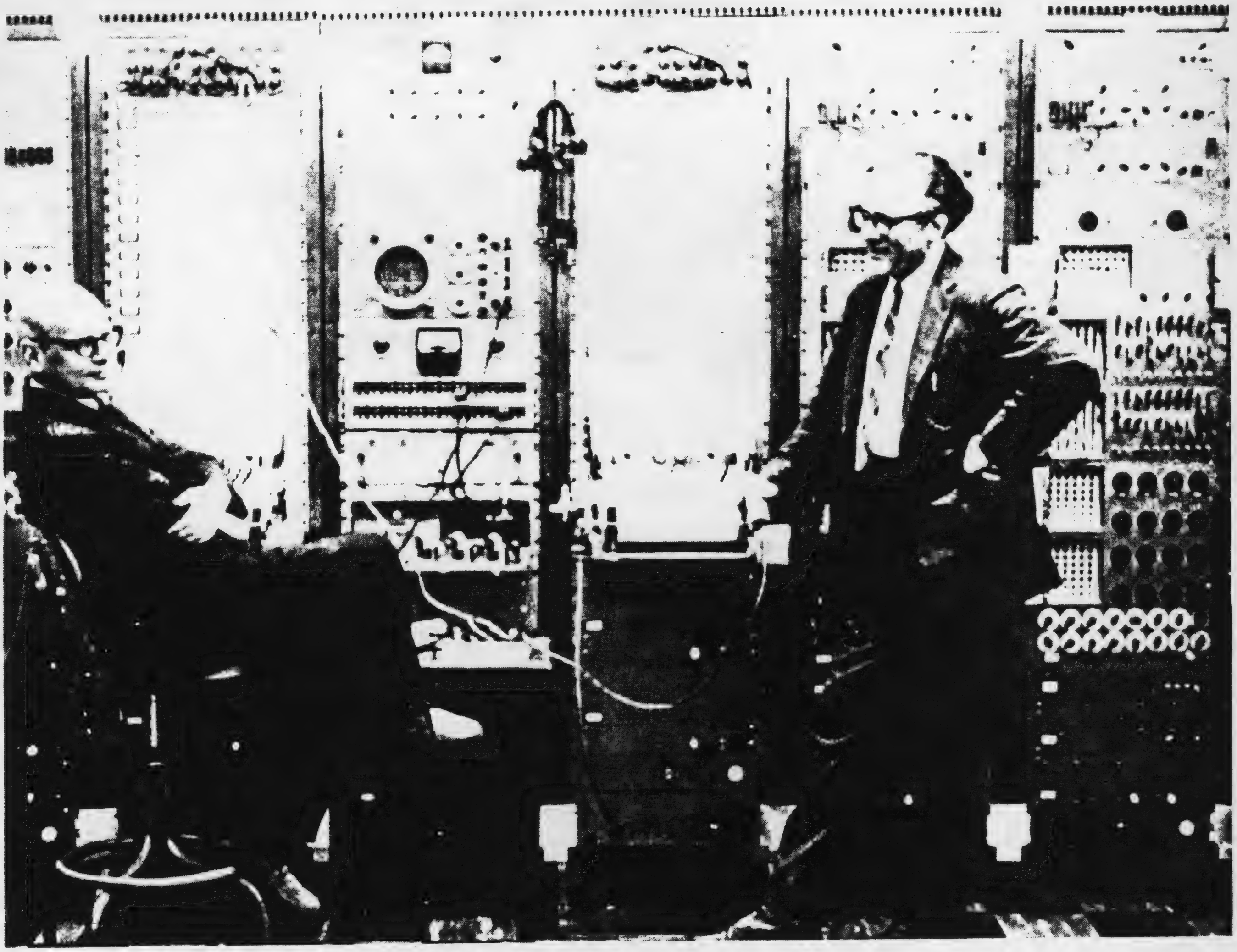
With all the advantages of new electronic equipment, the primary concern of the composers at the Columbia-Princeton Electronic Music Center remains making music. In all of these discussions one important consideration was made clear; electronic music is neither a style nor a type of music. Ultimately, the impact of a piece of music does not depend on the sound resources used, but on the skill of the composer.

THE EARLY YEARS

Foremost among the pioneers of electronic music are Vladimir Ussachevsky and Otto Luening. These composers collaborated on a number of works, producing the first major American works for the medium. In the 1950s Luening and Ussachevsky worked together,pioneering combinations of sounds prerecorded on magnetic tape and used in conjunction with the orchestra. The result was compositions such as *A Poem in Cycles and Bells*, 1953-54 (CRI 112) and *Rhapsodic Variations*, 1954 (Louisville 545-5), both of which are for tape and orchestra. Luening and Ussachevsky had a profound influence on younger composers, notably Luciano Berio; and the studio they formed became the world-renowned Electronic Music Center at Columbia University.

A 1952 concert of tape music at the Museum of Modern Art in New York highlighted several works by Ussachevsky and Luening and opened the door to a decade of research and experimentation attracting world-wide attention. This concert is documented on the Desto recording titled *Tape Music: An Historic Concert* (Desto 6466, still available.)

In 1959 the Columbia-Princeton Electronic Music Center was founded. By modern standards facilities were limited, but they did include the early RCA synthesizer (later replaced by the Mark II synthesizer), some additional equipment for generating and processing electronic sounds, tape recorders, mixing boards, and the means to edit magnetic



Milton Babbitt and Vladimir Ussachevsky

tape to produce tape compositions.

By the 1960s the Columbia-Princeton Center had attracted outstanding composers including Mario Davidovsky, Milton Babbitt, Charles Wuorinen, Charles Dodge, Pril Smiley, Halim El-Dabh, and Bülent Arel, who pioneered some of the first successful applications of computer-generated sounds.

neered some of the first successful applications of computer-generated sounds.

In the beginning, the composers of the Columbia-Princeton Center used techniques that were similar to those developed by French composers Pierre Schaeffer and Pierre Henry in their studio. The name of the technique, *musique concrète*, referred to the transforming of sounds from the real world on magnetic tape. Composers took a variety of approaches to the technique. Ussachevsky and Luening, for example, manipulated the sounds of conventional instruments by recording the sounds, then altering them by splicing, changing the speed, and editing out part of the sounds.

Subsequently Ussachevsky used oscillators in order to produce sound electronically. Davidovsky and Babbitt did much the same thing to transform sound; for a resource Davidovsky used synthesizers such as the Buchla. Babbitt used the RCA synthesizer and the next generation RCA Mark II synthesizer, built by Bell labs in the mid 1950s. Since that time, choices have broadened considerably, as I discovered in talking with these composers.

In his essay entitled "Sketch for a New Esthetic of Music," (1907) Ferruccio Busoni (1866-1924) imagined the coming of machines that would allow more timbral and rhythmic flexibility than existing instruments. Expanding on Busoni's ideas, Edgar Varèse (1883-1965) wrote an essay called "The Liberation of Sound" and composed the landmark works *Déserts* for instruments and tape (Columbia MS 6362) and *Poème électronique* (Columbia MS 6164). The contributions of these composers steered me toward some of the questions asked in these interviews.

Ussachevsky

VLADIMIR USSACHEVSKY

"I think that we always have to keep in mind that human perception is the limiting factor to the usefulness of sound produced by machines," Ussachevsky said in 1976 when I asked his reaction to Busoni's polemic. "When I speak of usefulness, I keep in mind that it is most likely that both Varèse and Busoni (having been superb musicians) had in mind the sounds that could be used for musical purposes in a much expanded conception of music as it is or can become. There is no end to the sounds that machines can produce that cannot be perceived by the human ear or felt by other parts of the human body.

"The limiting factors of total control of sound synthesis and sound ordering by the computers now appears largely financial, but still larger looms the perennial problem: how soon will the truly expert and truly imaginative composers be in complete command of these resources? For the ultimate tool, the computer, that circumstance has not yet been obtained though a few impressive glimmerings are there. Perhaps we will even be able to bypass the ear one day."

Of the use of computers in future electronic music, Ussachevsky foresaw increased applications, adding that "As a matter of fact I would think that we will see some very significant results in terms of sound quality within a very few years. Maybe within two or three years or five years at the most. . .It is obvious that they [computers] possess great speed and enormous possibilities to resolve complexities. Despite the increased choices, the composer has still got to be the person who will decide."

In 1976 Ussachevsky said, "There are people who expect to produce a kind of an instrument – they usually think in terms of something like an electronic organ – that would make it possible for the businessman to come home, have his martini, and then sit down and be able to play Beethoven's Fifth Symphony or compose, or whatever. In other words, an Everyman's instrument that is so well laid out that anyone can play it."

Today Ussachevsky states, "Currently, there is a new generation of people whose arrival point in music begins with electronically generated sounds," and he wonders how these people will get a feeling for composing for traditional instruments or learn how to perform on traditional instruments. He notes that the computer is now found everywhere, and like the piano in the 19th century, every home seems to have one. He believes that history is repeating itself; like the glut of piano music produced in the 19th century, there is now a flurry of activity in composing for electronic instruments. Ussachevsky assumes that just as much of the more mediocre piano music has died a natural death, so will much of the current electronic music.

In 1987 Ussachevsky sees too great a dependence on tape loops and sequencers that produce an ostinato effect. He notes that the predominant philosophy in technology seems to be one of copying the sound of existing instruments. This is counter to the attitude of the composers who did the early work at the Columbia-Princeton Center; they wanted to produce sounds that went beyond the sounds of conventional instruments, not merely to imitate them. Ussachevsky still believes that the approach taken in *musique concrète* was valid in that composers had to demonstrate how they would use transformed sounds effectively. "Earlier, the synthesizer was used for its own unique sound, not for replacing instruments."

Ussachevsky feels that one of his most significant works is *Colloquy* for symphony orchestra, tape recorder, and various chairs. *Colloquy* was premiered in 1976 by Maurice Abravanel and the Utah Symphony. It will soon be released on a CRI recording with *Dialogues and Contrasts* for brass quintet and taped sounds premiered by the American Brass Quintet in 1984. *Colloquy* was produced using transformed sounds and electronic sounds in combination with the orchestra; the quintet piece has a tape part consisting of individual brass sounds and chords from brass instruments. Ussachevsky still prefers transforming the sound of conventional instruments, but does not avoid synthesized sounds.

Following a 17-year period of composing almost strictly electronic music, Vladimir Ussachevsky has now, to some degree, turned away from electronic sounds. He presently has four commissions: a piano sonata, a string quartet, a piece for the 100th anniversary of Pomona College, and a concerto for E.V.I. (electronic valve instru-

Luening

ment). Designed by Nyle Steiner, the E.V.I. resembles a brass instrument except that it is used as a breath sensitive input to a synthesizer. It has great flexibility in range and timbre.

OTTO LUENING

Luening had a prescient prediction about electronic music in 1976. "I think it will probably get into the pop field. They'll use certain computer techniques of variation on a theme and they'll get what amounts to variations on a theme based on the last pop tune. They'll get somebody in there who will listen to these fifty thousand variations and select the best one without having to compose it."

To Luening, electronic performance is a valuable means of accurately representing the score, especially in the case of a difficult work. As he explained, "Some music that is written today is extremely difficult for performers and although it can be played if you have 35 rehearsals of it, it's very difficult to get budgeting for it. In that case, electronic music for certain very difficult music could be substituted with the direct intent of it being reproduced by a loudspeaker. I see that whole area as quite valid and quite interesting."

MARIO DAVIDOVSKY

Mario Davidovsky was born in Argentina in 1934 and now lives in the United States. He is well known for his works combining tape and live instruments, particularly the Synchronisms *series. His* Synchronisms for Piano and Tape *won a Pulitzer Prize.*

Speaking in 1976, Davidovsky gave his thoughts on the future of electronic music and described, in part, the coming revolution of MIDI. "If we are thinking in terms of cause and effect relationships," he said, "then I would assume that computers are going to become cheaper, and those designed for sound production might become a more predominant reality. In the near future, we are going to see some kind of a combination computer-synthesizer. I think this will happen because the synthesizer is an instrument that is used very much in business and in the commercial aspect of music. This is where a tremendous amount of money is being directed and it is attractive to this kind of industry because they could develop it and look for some kind of reward, financially. So maybe the next thing will be some kind of a super-glorified, computer-controlled organ. But I see everything revolving more towards a device with complete electronic control over operations rather than just cutting tape and all of those kind of medieval procedures that we used to use very much. I think that that would probably be the next logical step."

Today Davidovsky feels that it is impossible to keep up with all the innovations in technology. "Much of the work today is caught up in exploration of the sound and not paying attention to the music. All technology has shortcomings and advantages [for producing music]. Often there is too much emphasis on the power of the equipment rather than creating significant music. Those people who are pioneering techniques in sound production are probably developing a basic grammar for a future music syntax."

Davidovsky

He sees limitations of the keyboard, observing, "Associating the keyboard with the synthesizer took away from what we were doing in the 1960s – trying to do things with electronic sound that regular performance techniques would not allow. Now these instruments are being used to replace real musicians in order to save money. I think possibly this will backfire and later these people will crave the sounds of conventional instruments."

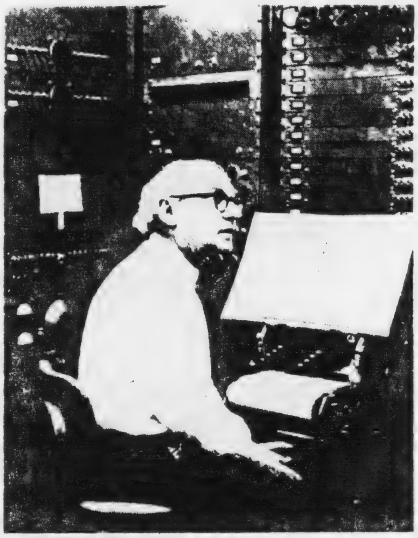
From 1960 to 1965 Davidovsky's primary approach to electronic composition was to combine sounds on tape with conventional instruments. Because this was so successful, everyone then wanted him to compose a piece "for tape and. . ." As a result, he decided in the 1970s to dedicate time to writing for conventional instruments. Getting back in the mainstream, he says, made composing seem fresh and new. Davidovsky has not abandoned the use of tape by any means; since 1976 he has composed *Synchronism No. 7* for orchestra and tape and *Synchronism No. 8* for woodwind quintet and tape.

Davidovsky still finds the technique of combining electronic and acoustic sounds the most exciting because he feels that the addition yields an outcome larger than the sum of the two. He stands by the electronic music from the 1950s and notes that today there are many more performers who can perform difficult instrumental parts, such as those in his often-played *Synchronisms*.

Davidovsky will venture into relatively new territory for sound resources when he works on his next piece, a work for violin and tape commissioned by M.I.T. The commission stipulates that the composer produce the tape-recorded sounds at the computer labs of M.I.T. Although the equipment there is new to Davidovsky, he says that he will use almost the same approach to the notation as he used for his *Synchronisms*, which shows what is occurring for the tape and the acoustical instruments. Notating pitch and rhythm is quite easy in electronic music, he says, but when elements like white noise or other kinds of noise are used, notation becomes more difficult.

MILTON BABBITT

A trained mathematician as well as musician, Milton Babbitt was the first composer to turn to total serialization. He took the twelve-tone techniques espoused by Arnold Schoenberg and applied them to rhythm, dynamics, timbre, and register, as well as to pitch. Babbitt wrote the first entirely synthesized composition of any length, Composition for Synthesizer *(1961). He has also written many works for tape and performers, notably* Philomel *for soprano and tape.*



Babbitt

Asked who or what existed in 1976 that he thought would prove to be profound in the history of electronic music, Milton Babbitt, then composer and faculty member in the mathematics and music departments of Columbia-Princeton, foresaw the age of personal computers in music. "Micro, even more than mini [computers] will make it possible for us to have our own musical computer centers. That's not available and that's the trouble because we're dependent upon the general computer installations.

"The other prospect is the use of the computer as an analytical tool as it already had been used and is being used in a very limited sense so far. So, I think that one is going to find out a great deal more about music."

Babbitt expressed a growing concern among contemporary composers that new music is very expensive to copy parts for and expensive to rehearse, expensive to perform, and difficult to program. Discussing his *Paraphrases* for 10 winds and brass, piano, and conductor, Babbitt said, "This piece demonstrates the impossibility of interpreting vastly difficult rhythms and the huge limitations of notation... These are not difficulties of perception but of notation." Because of these performance problems Babbitt has experimented with different ways of notating rhythms so as to produce the same temporal effect but be easier to read and play.

Today Babbitt believes the greatest benefit of computers to the composer is their ability to generate and transform sounds. "Anything you can discriminate, you can structure and utilize in computer music," he explains. Due to problems in getting contemporary music performed, he has concentrated on smaller works such as his commissioned piece for saxophone and piano and *Images*, for saxophone and tape. Babbitt states, however, that he "would have turned to computer production of sound entirely had it become available earlier." Even in 1976 he said, "I...cannot see why after a certain amount of knowledge is gained, anyone would use anything but the computer. I see no reason in the world, for example, why one can't mix these things on the computer. In practice, it is very likely that all of these things will co-exist."

Since 1976 Milton Babbitt has not composed much music using electronic sounds, due in part to a burglary at the Columbia-Princeton Electronic Music Center. The burglary ruined many of the connecting wires for the Mark II synthesizer and spoiled plans for a piece that Babbitt was working on at the time. However, he has completed a piano concerto, available on New World Records, and *Transfigured Notes*, which will be premiered by Dennis Russell Davies and the strings of the Philadelphia Orchestra.

Due to problems with notation and the difficulty of live performers accurately capturing his intricate writing, Milton Babbitt still prefers the beauty of working in the classic electronic studio and producing entire works on tape. For him, "The most satisfying feeling is that of combining the role of composer and performer and walking out of the studio with the completed tape."

PRIL SMILEY and RUSSELL PINKSTON

Associate Directors of the Columbia-Princeton Electronic Music Center, Pril Smiley and Russell Pinkston are also active as composers.

In 1976 composer Pril Smiley was in accord with Mario Davidovsky's view that commercial sales would probably influence the design and availability of future electronic sound resources. "I think the use of equipment in the commercial field is going to have a large effect on what the rest of us are doing," he said. "That's where the money is and that's what will determine where the money will go to design the equipment. It seems that the commercial people will design with a heavy emphasis on keyboard and pitch and I know a lot of composers who wished that that kind of thing would not be emphasized. They would like to get away from keyboard mentality. The small university professor and the independent composer don't have much to say on the design of equipment because they don't have the money to put into it."

But Russell Pinkston, one of the New York composers who is most familiar with the new technology, is pleased with the directions that have been taken, both in equipment design and in composition. In the early days of electronic music, Pinkston explains, there were just four types of electronic music, *musique concrète*, magnetic tape used to manipulate electronically generated sounds, sounds generated on mainframe computers, and voltage-controlled synthesizer music. The major advances in technology since the 1970s have brought with them a broadening of compositional styles.

Pinkston

"The development of the Synclavier and a similiar control system from Australia known as the Fairlight have enabled composers to use computers more effectively," says Pinkston. "With this type of technology, composers no longer need to know how to program in order to use computers for musical purposes." While computer commands were previously too cumbersome to be used efficiently, today's faster digital synthesizers give composers an edge.

"The rise in the popularity of personal computers has enabled many more users to control digital synthesizers with their own P.C.s," he explains, "and the establishment of a standard system of communication that could be used between new electronic instruments [MIDI] greatly facilitated composers' work."

Besides the fact that profound advances in programming and storage capabilities were made in digital synthesis, says Pinkston, the variety of synthesizers available today offer technology that is of use to a wide range of musicians and composers, from the novice to the sophisticate.

Pinkston feels that the most exciting use of digital synthesis is in the area of pop music, but that early works by composers such as those at Columbia-Princeton represent historic masterpieces. He notes that when the earlier works were pioneered they often were not accepted due to the newness of the sounds, but that pop music has now made electronic sounds more acceptable to listeners.

In composing his own music Pinkston most often uses commercially available software. *Synthony*, for example, is a synthesis of acoustic and electronic sounds mixed into four movements. To write the piece Pinkston used digital synthesizers controlled by

MUSIC EDUCATION

The composers interviewed had various ideas on introducing electronic music into curricula at all levels of schooling. "It should be made known that this all did not just begin in 1987," said Ussachevsky. "Teachers need to investigate the electronic concert pieces from the 1950s." Davidovsky pointed out the problems in trying to gain appreciation for contemporary music in general, and that this same problem exists in regard to music using electronic sounds. Pinkston pointed to the wealth of software available for computer-assisted instruction covering most aspects of music, advising that in order for teachers to get in touch with what technology can offer them, they should purchase synthesizers and computer software to use in their departments. "Until you directly experience the technology," he said, "you can't appreciate its potential applications."

computer. Improved technology has helped Pinkston. "Previously this type of composition would have used tape splicing," he says, "but now the sounds can be mixed using computer software."

A quartet for four horns and electronic tape by Pinkston will be released on CRI records. The work *Emergence* has been released on a recording called *The Dartmouth Digital Synthesizer* (Folkways Records), named for the synthesizer that was designed by John Appleton and served as the prototype for the Synclavier marketed by New England Digital.

Who are some of today's important electronic music composers? Pinkston noted several. "Reynold Weidenaar is important for his electronic music used in conjunction with video and film, such as *The Stillness*. Charles Dodge began some of the earliest work in this country in using computers in musical composition at the Columbia-Princeton Center. Notable works by Dodge include *The Earth's Magnetic Field* and *The Story of Our Lives*. The latter uses speech synthesis: human speech is digitized (converted into numbers), analyzed as to the characteristics of sound, and then resynthesized electronically.

"Morton Subotnik is known for his recent works known as 'the ghost pieces,' including such works as *Parallel Lines* and *The Double Life of Amphibians*. In these works, a 'ghost box' has a computer program that randomly transforms the sounds of live instruments playing into microphones filtered through the box. This adds a more spontaneous feeling to the performance.

"Jonathan Harvey wrote *Mortuos Plango, Vivos Voco*, which is very akin to the work of the *musique concrète* composers. In this composition, he used fragmentation, looping, and shifting to transform the sounds of a church bell and a choirboy." ■

GENERAL BACKGROUND INFORMATION

FAMOUS PEOPLE INVOLVED IN ELECTRONIC MUSIC -

WIDELY KNOWN STUDIO SYNTHESIZERS IN USE TODAY

THE "SWITCHED-ON" PROCESS

IMPROVISATION (IMPROVISE)

SUGGESTIONS ON HOW TO COMPOSE IN ELECTRONIC MUSIC

HOW TO START

Begin your composition with a basic idea. This might be a single sound that you like, one of your experimental tapes, a group of pitches, an interesting rhythm, or a specific modification technique that you would like to explore. The idea for the composing project might stem from a non-musical source such as a light or slide show, a poetry reading, or a play, dance, or film that you plan to accompany with music.

Your next step is to think out a number of possibilities for developing, expanding, and exploiting the basic idea. For example:

1. A taped event can be played forwards or backwards; altered by speed change; modified in timbre; edited to change its duration, sequence, or envelope; made into a loop; or played against itself in a multi-layered texture.

2. A pitch group can be recorded forwards or backwards or in varying pitch sequences; modified by speed, timbre, or register changes; made into layers of simultaneous but contrasting loops; and, if played on a synthesizer keyboard, the intervals can be varied.

3. A rhythmic idea can be stretched, condensed, fragmented, or looped; and recorded on different pitch levels with new timbre and varying envelopes.

4. A modification technique - such as reverb or filtration can be applied to a succession of events produced by one sound source, or by several related or contrasting sources.

5. Words or staged events are especially helpful. They suggest mood, sequence, durations, and the function (background) of your music.

HOW TO CONTINUE

Try to keep a relaxed attitude toward the project, and an open mind about new developments and unexpected changes that turn up in the course of an experiment. Don't lock yourself into one way of thinking.

Don't concern yourself about the length of a composition. A thirty second or one minute piece can convey a lot.

If you can't get started, make a list of experiments that you can run with one of your favorite tapes. Then try out new ideas that come out of the experiments, and new ways of editing and combining the sounds you have. Work by trial and error until you begin to develop interesting material.

If you get stuck, bored , or frustrated, or run out of ideas, try to be more objective about the project. Stay away from it for a while so that you can think things out and isolate your problems. If you are still dissatisfied, work out variations of the same tape, fresh combinations of material, unplanned modifications, or new sound sources.

If the basic material seems dull, expand the scope of your experiments. Flat, static, or uncompromising sounds may yield surprisingly good results if you open new paths of exploration.

If the piece is monotonous, redesign your sounds with more variety. You can create tension by using:

1. fast tempos, accelerandos
2. crescendos to high loud pitches
3. sudden silences
4. thick or abruptly shifting textures
5. unusual timbres
6. extreme frequencies
7. sharp contrasts of material

If the music is too compact, and seems to rush too quickly through the event sequences, you can create relaxation by using:

1. slow tempos, ritardandos
2. diminuendos
3. expected silences
4. thin or gradually shifting textures
5. conventional timbres
6. soft sounds in the medium and low range
7. repetition
8. subtle changes of character from one event to another event.

If the music seems shapeless, or tends to wander aimlessly, try to reorganize your materials into sections which, although related from one to the next, have a definite character and a clear shape. One section, for example, might contain only unusual timbres, rapid pitches in sequence, or clangorous bell sounds. This in turn, might be tied in with the next section (also with its own character) by threading an occasional appearance of one of those sounds through the new texture. If you work this way, or in any way that combines unity with variety, the music will "hang" together.

GENERAL CONSIDERATIONS IN FOUR TRACK RECORDINGS -

1. Keep the material simple. Complexity will occur in the interaction of the mulitiple lines.

2. Allow for intermittent silences or fade-outs in a given layer. This varies the thickness of the overall texture, and leaves room for latter events to be heard.

3. Choose distinctive timbres for each layer, since lines of similar color (especially in close proximity) tend to confuse the ear.

4. Assign different sounds to different frequency bands. For example, a four layer texture could contain these sounds:
    A. High register - random samplings of a waveform
    B. High medium - modified voice sounds
    C. medium - fixed pitch sequence
    D. low - a rhythmic pattern (white noise with a percussive envelope), or a synthesized string bass line.

   This sort of spatial seperation keeps sonic movement intact, and allows the ear to hear one sound moving in one register.

5. Follow the same principles as used by orchestrators.

6. Rich, thick or lound sounds need reverberation space. Keep other layers out of their frequency band.

7. Two or more layers of thin sounds - or comparatively soft ones in the lower frequency range can move compatibly in the same register.

8. Keep events simple and spacious in the low register, with ample "breathing" room. Reserve the upper register for complex sounds, rich timbres, rapid figurations, and the mixture of multiple lines.

FURTHER CONSIDERATIONS IN REALIZATIONS......

REPETITION

VARIATION

CONTRAST

PITCH DURATION

TIMBRE INTENSITY

SPATIAL POSITIONING

SOUND EVENTS

SOUND LAYERS

FIRST SYNTHESIZER REALIZATIONS

A realization showing *TENSION*

A realization showing *RELAXATION*

FORMAL ELECTRONIC MUSIC PROJECTS

A-B-A FORM

A-B-A is a three-part form consisting of two sections of similar character seperated by a middle section of contrasting character.

To make this form work, be especially careful of sectional balance - a matter that has less to due with equal durations than with the nature of your material. For example, a powerful middle section may need longer development than the end sections; or a weakly developed opening (first A) may call for a richer, broader restatement at the end (second A); or a brief, wrap-up finale may be just enough to suggest and balance a strong, lengthy first section.

A DESCRIPTIVE PIECE

The essence of a descriptive piece is its capacity to evoke a specific image.

Ideas such as children at play, a tidal wave, wind in the trees, a battle, an ancient legend, the seasons, a painting, a landscape, machinery, a celebration, outer space.

The difficult element is the selection of the mood to evoke the image. Mental imagery is highly subjective (sounds of war in your mind may conjure up an earthquake in your audience's)

Obvious images are easier to evoke; for instance, we frequently associate outer space with eerie sounds and strange silences. But subtler images - like the four seasons, a landscape, a myth - are far more difficult. Choose your materials and modifications with care, but your descriptive title as well.

A MOOD PIECE

The essence of a mood piece is its capacity to evoke a specific emotional response in the listener:

agitation, anguish, celebration, comedy, drama, ecstasy, elation, enchantment, exuberence, fright, fury, gaiety, horror, impending doom, meditation, mystery, pain, passion, peacefulness, playfulness, ordeal, resignation, savagery, solemnity, tenderness, tension, weariness

First, choose material and modifications that seem to evoke the desired response; second, develop the material but reject anything that deviates from a consistent mood; and third, try to sense how far you can go without overstating the point of the piece, or lapsing into useless repetition.

ELECTRONIC MUSIC I

SPECIALIZED PROJECT

AUDIO REALIZATION OF A FRUIT or VEGETABLE

Your realization is to convey the following aspects of the fruit or vegetable that you have chosen:

1. Its contour and/or shape
2. Describe its color
3. Does your item have a "sound" that is connected with it
4. Is your produce "ugly" or "beautiful"
5. Does your produce create an emotional response from someone eating it.

GENERAL RECORDING FORMAT

project

words and music

One of the most interesting projects for the electronic music composer (or any composer) is the creation of sounds to accompany the spoken word. The verbal part—a poetry reading, stage play, improvised talk, vocal sounds, or material taped from records, radio, or TV—may be unaltered or modified by tape techniques and incorporated in the music.

To create sounds for a reading or stage production, begin by answering such questions as:

- What is the mood of the words?
- How and when does the mood change?
- What is the pacing of the words (or the tempo of the stage action)?
- Does the text need a mood-setting introduction? a conclusion?
- Are certain sections more effective without music?
- Are there staging gaps, with no one speaking, when continuity would depend on music?
- Are there silences in the speech that need music in the foreground?

If, on the other hand, you intend to use speech or vocal sound as an integral part of a musical complex, treat it as a sound to be modified like any other.

Voice sounds frequently carry emotional overtones and evoke specific images. For example, the words "power," "death," and "magic" carry connotations which can add dimension to a piece. A sigh, heavy breathing, or an echoing scream can call up strong images in the listener's mind.

A nonsense word—a meaningless, made-up sound—can be funny, threatening, or mysterious, provided that we modify the sound accordingly.

Foreign-language words, as sounds, can also be suggestive. Think of your reaction to soft words like "sempre caro" or "les violons d'autan," harsh sounds like "achtung" or "sehr gut," the rhythm of Chinese, or the sonorities of Spanish or Russian. (Check out the literal meaning in case the effect might be altered for the listener who understands the language.)

For examples of this type of work, listen to some of the following:

Ashley: *She Was a Visitor*
Babbitt: *Vision and Prayer*
Berio: *Visage*
    Omaggio a Joyce
Cage: *Solo for Voice 2*
El-Dabh: *Leiyla and the Poet*
Feldman: *Chorus and Instruments (II)*
Gaburo: *Antiphonie III*
Oliveros: *Sound Patterns*
Reich: *It's Gonna Rain*
Stockhausen: *Gesang der Jünglinge*
Takemitsu: *Vocalism Ai (Love)*

ELECTRONIC MUSIC I

A GENERAL REALIZATION WHICH DESCRIBES A "MOOD" OR "FEELING.

REALIZER ________________________________

ELECTRONIC MUSIC I

A COMPOSITION WHICH DESCRIBES A SPECIFIC IMAGE, IDEA, EVENT OR OTHER ASPECT IN WHICH THE COMPOSER WISHES TO CONVEY.

REALIZER________________________________

PROJECT EVALUATION (1987) ____________________

Project

____________________ ________________

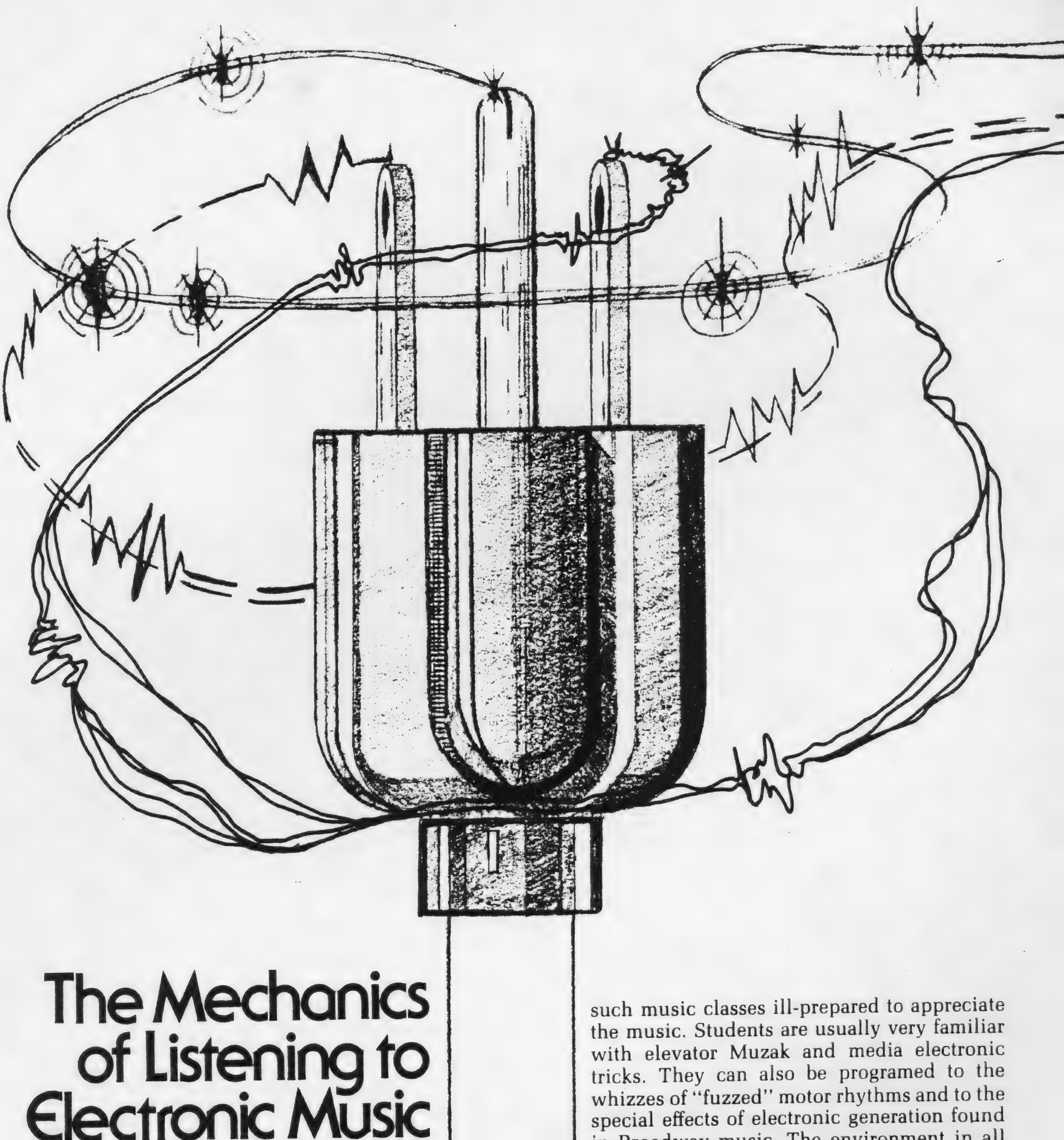
Technician Letter Date

Tape Quality................	5	4	3	2	1	0
Good use of synthesizer.....	5	4	3	2	1	0
Use of recording techniques.	5	4	3	2	1	0
Changes in dynamics.........	5	4	3	2	1	0
Shows "direction"...........	5	4	3	2	1	0
Reflects "mood".............	5	4	3	2	1	0
Balance of audio spectrum...	5	4	3	2	1	0
Did not over/understate.....	5	4	3	2	1	0
Variations in timbre........	5	4	3	2	1	0
Effective panning...........	5	4	3	2	1	0
Use of repetition...........	5	4	3	2	1	0
Shows sincere effort........	5	4	3	2	1	0
OVERALL EFFECTIVENESS.......	5	4	3	2	1	0
	5	4	3	2	1	0

TOTALS ____________

____

Evaluator



The Mechanics of Listening to Electronic Music

David Cope

The focus of most electronic music classes is, appropriately, that of synthesizer mechanics. It is, however, of great importance that the teaching of listener understanding and sensitivity should also have a place in these classes. In the past ten years there has been at least a fourfold increase in student interest in electronic music, but students often come to such music classes ill-prepared to appreciate the music. Students are usually very familiar with elevator Muzak and media electronic tricks. They can also be programed to the whizzes of "fuzzed" motor rhythms and to the special effects of electronic generation found in Broadway music. The environment in all but the most rural of situations provides a generic program of electronic noise. But students have had few actual musical experiences.

All of this "exposure" provides less than a perfect foundation for the creation of any aesthetic in regard to the listening to and understanding of electronic music. While teaching synthesizer operation can and should be the core of any electronic music program, it is vital to also teach the mechanics of *how to listen* to and *understand* electronic music and *all* new music. Some students who are programed to electronic gimmicks are resultantly hostile

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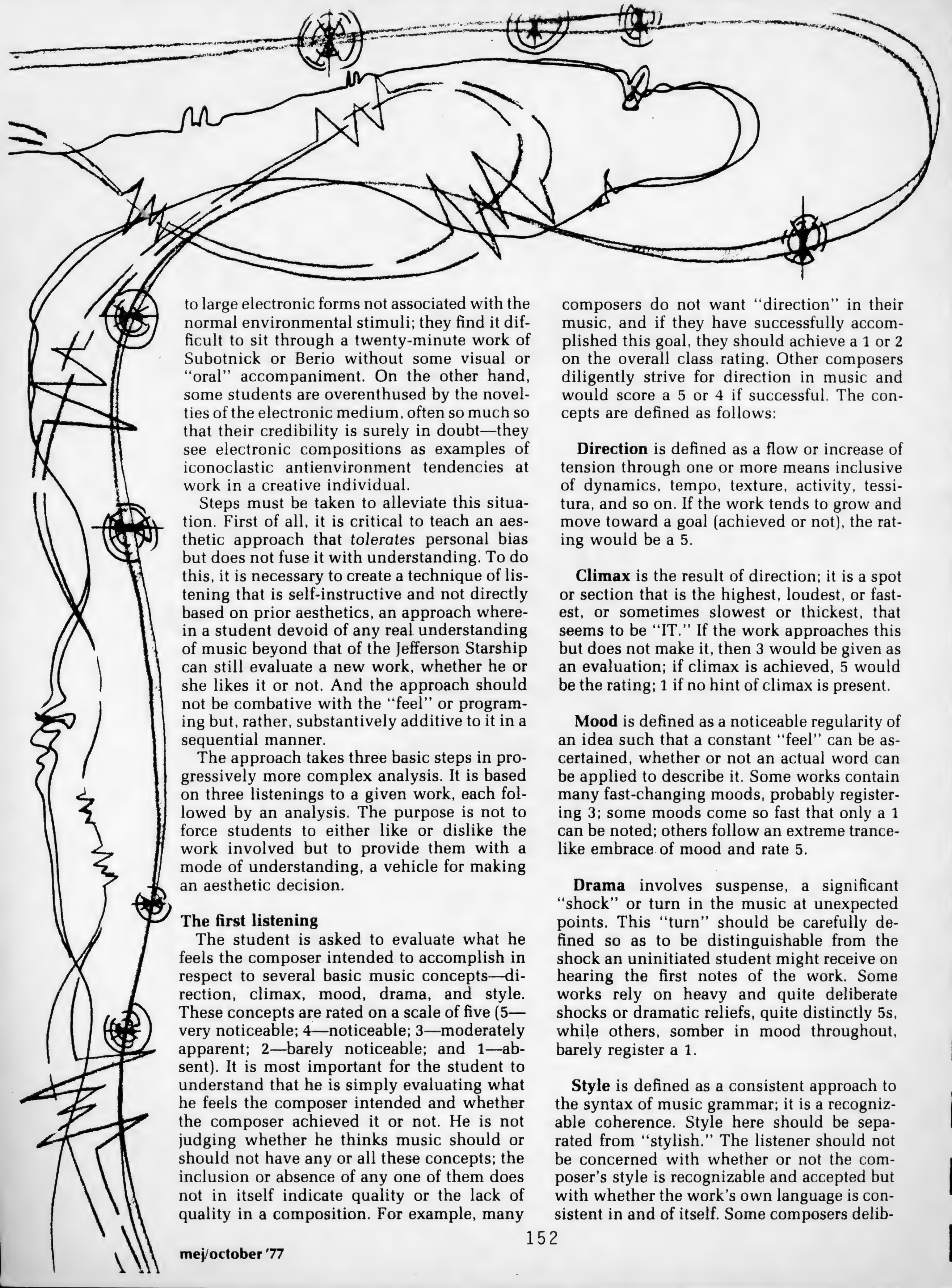


to large electronic forms not associated with the normal environmental stimuli; they find it difficult to sit through a twenty-minute work of Subotnick or Berio without some visual or "oral" accompaniment. On the other hand, some students are overenthused by the novelties of the electronic medium, often so much so that their credibility is surely in doubt—they see electronic compositions as examples of iconoclastic antienvironment tendencies at work in a creative individual.

Steps must be taken to alleviate this situation. First of all, it is critical to teach an aesthetic approach that *tolerates* personal bias but does not fuse it with understanding. To do this, it is necessary to create a technique of listening that is self-instructive and not directly based on prior aesthetics, an approach wherein a student devoid of any real understanding of music beyond that of the Jefferson Starship can still evaluate a new work, whether he or she likes it or not. And the approach should not be combative with the "feel" or programing but, rather, substantively additive to it in a sequential manner.

The approach takes three basic steps in progressively more complex analysis. It is based on three listenings to a given work, each followed by an analysis. The purpose is not to force students to either like or dislike the work involved but to provide them with a mode of understanding, a vehicle for making an aesthetic decision.

The first listening

The student is asked to evaluate what he feels the composer intended to accomplish in respect to several basic music concepts—direction, climax, mood, drama, and style. These concepts are rated on a scale of five (5—very noticeable; 4—noticeable; 3—moderately apparent; 2—barely noticeable; and 1—absent). It is most important for the student to understand that he is simply evaluating what he feels the composer intended and whether the composer achieved it or not. He is not judging whether he thinks music should or should not have any or all these concepts; the inclusion or absence of any one of them does not in itself indicate quality or the lack of quality in a composition. For example, many composers do not want "direction" in their music, and if they have successfully accomplished this goal, they should achieve a 1 or 2 on the overall class rating. Other composers diligently strive for direction in music and would score a 5 or 4 if successful. The concepts are defined as follows:

Direction is defined as a flow or increase of tension through one or more means inclusive of dynamics, tempo, texture, activity, tessitura, and so on. If the work tends to grow and move toward a goal (achieved or not), the rating would be a 5.

Climax is the result of direction; it is a spot or section that is the highest, loudest, or fastest, or sometimes slowest or thickest, that seems to be "IT." If the work approaches this but does not make it, then 3 would be given as an evaluation; if climax is achieved, 5 would be the rating; 1 if no hint of climax is present.

Mood is defined as a noticeable regularity of an idea such that a constant "feel" can be ascertained, whether or not an actual word can be applied to describe it. Some works contain many fast-changing moods, probably registering 3; some moods come so fast that only a 1 can be noted; others follow an extreme trancelike embrace of mood and rate 5.

Drama involves suspense, a significant "shock" or turn in the music at unexpected points. This "turn" should be carefully defined so as to be distinguishable from the shock an uninitiated student might receive on hearing the first notes of the work. Some works rely on heavy and quite deliberate shocks or dramatic reliefs, quite distinctly 5s, while others, somber in mood throughout, barely register a 1.

Style is defined as a consistent approach to the syntax of music grammar; it is a recognizable coherence. Style here should be separated from "stylish." The listener should not be concerned with whether or not the composer's style is recognizable and accepted but with whether the work's own language is consistent in and of itself. Some composers delib-

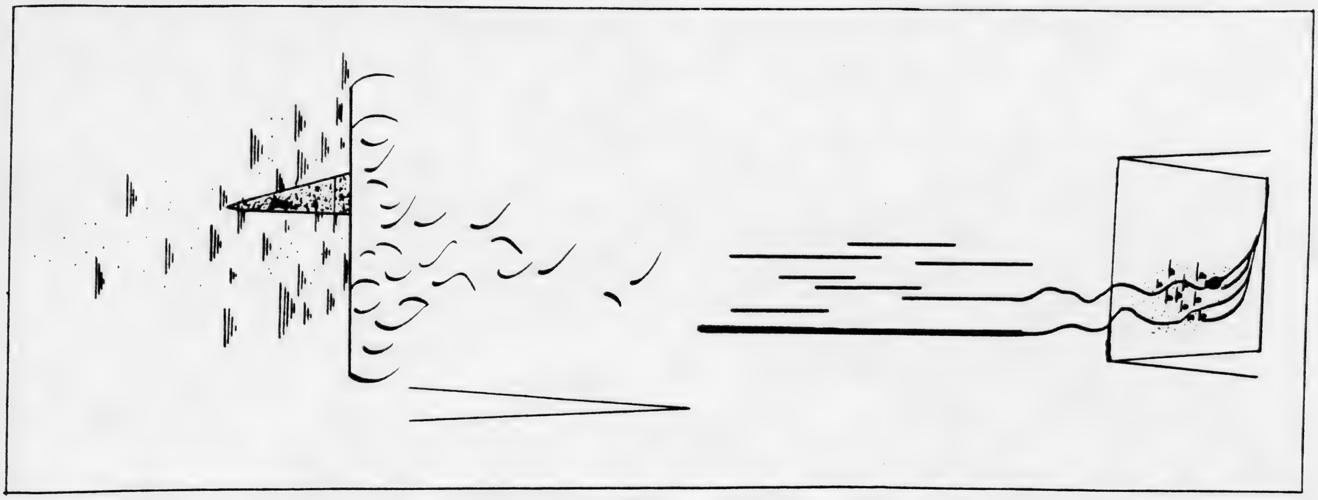
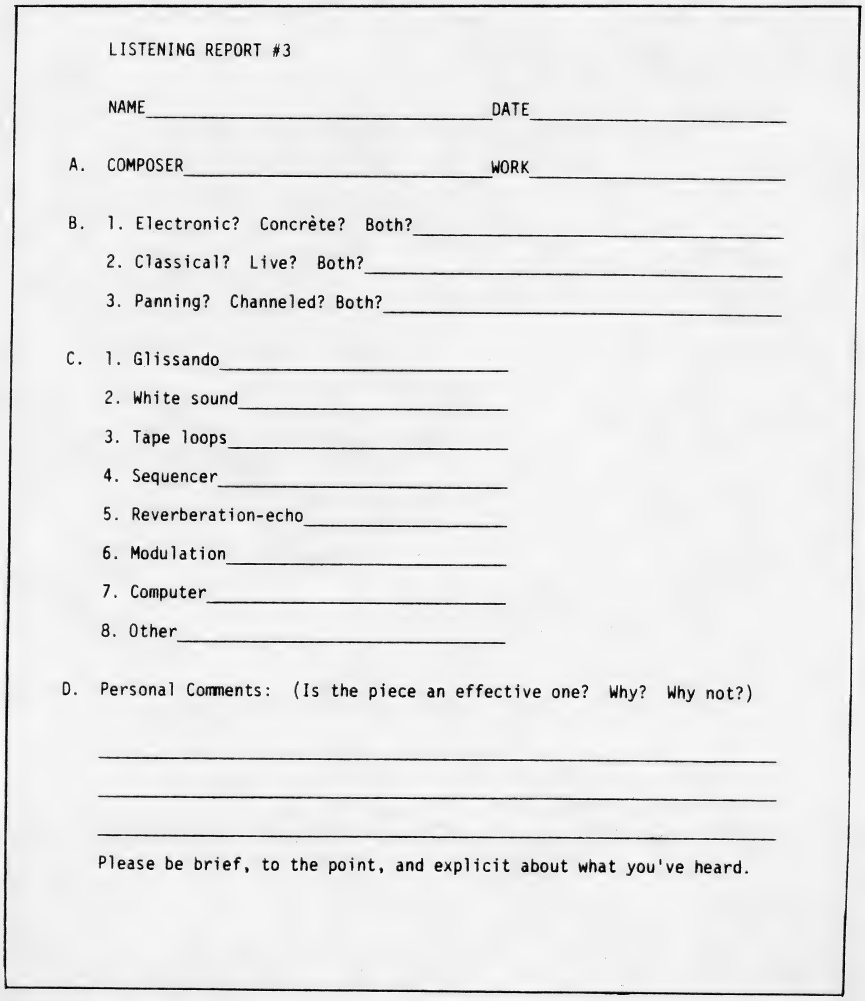


Figure 2



LISTENING REPORT #3

NAME______________________________ DATE________________________

A. COMPOSER__________________________ WORK________________________

B. 1. Electronic? Concrète? Both?________________________________

2. Classical? Live? Both?______________________________________

3. Panning? Channeled? Both?___________________________________

C. 1. Glissando__________________________

2. White sound________________________

3. Tape loops_________________________

4. Sequencer__________________________

5. Reverberation-echo_________________

6. Modulation_________________________

7. Computer___________________________

8. Other______________________________

D. Personal Comments: (Is the piece an effective one? Why? Why not?)

____

____

____

Please be brief, to the point, and explicit about what you've heard.

Figure 3

of overview graphics, the general flow is shown in Figure 2. After two listenings the student has a view of the given work on numerous planes: form, direction, climax, mood, drama, and style, with a real "feel" for the movement and tension/relaxation component of the work.

The third listening

This listening is based on a few mechanical understandings of electronic music both in terminology and function. Its primary intent, however, is to give the student a practical "orchestration" understanding that is essential in order to analyze the work's effectiveness.

erately overlay contrasts to avoid recognizable style (1); others go out of their way to achieve it (5).

As an example of listening according to this method, the author's *Teec Nos Pos* was analyzed by himself and by thirteen different classes at Miami University, Oxford, Ohio. The choice of the author's own work reflects not ego so much as the clear knowledge of what the composer intended and whether the students understood it.

Teec Nos Pos[1] was created with the following desired criteria in mind: Direction—5; Climax—5; Mood—3 (complex); Drama—2; and Style—4.5. The results of ten different classroom judgments by more than 220 listeners achieved the following pattern: Direction—4.8; Climax—3.5; Mood—3; Drama—2.5; and Style—4.

While the students exactly matched the intended response in only one area, the ratings are amazingly close. The student comes away from the first listening with a distinct evaluation of the work that can be compared to his evaluation of other works and the analyses of his classmates; most important, his analysis has remained separate from his tastes. He can love, hate, or have no response to the work and still have concrete information to help form later judgments, comparisons, and appreciations.

The second listening

This performance of the work is a much more subjective listening experience that begins to internalize the work in the student's mind. The student is asked to sketch in his own manner a visual or graphic view of the work. This proportional (time-space) view on sketch paper can, if treated seriously, give the student, his classmates, and the teacher a viable and credible insight into his understanding or the lack of it. It is usually best to outfit the listener with a brief suggested guide to the graphic concept. Some hints in this direction are given in Figure 1.

If the sketch is done on translucent sheets with time lines defined, a great deal can be accomplished by overlaying graphic form designs. But whether this is attempted or not, the student has at his disposal a credible view of the entire work that he can sit back and view in its entirety, picking out successful, liked or disliked, or even terribly weak sections. While *Teec Nos Pos* received a variety

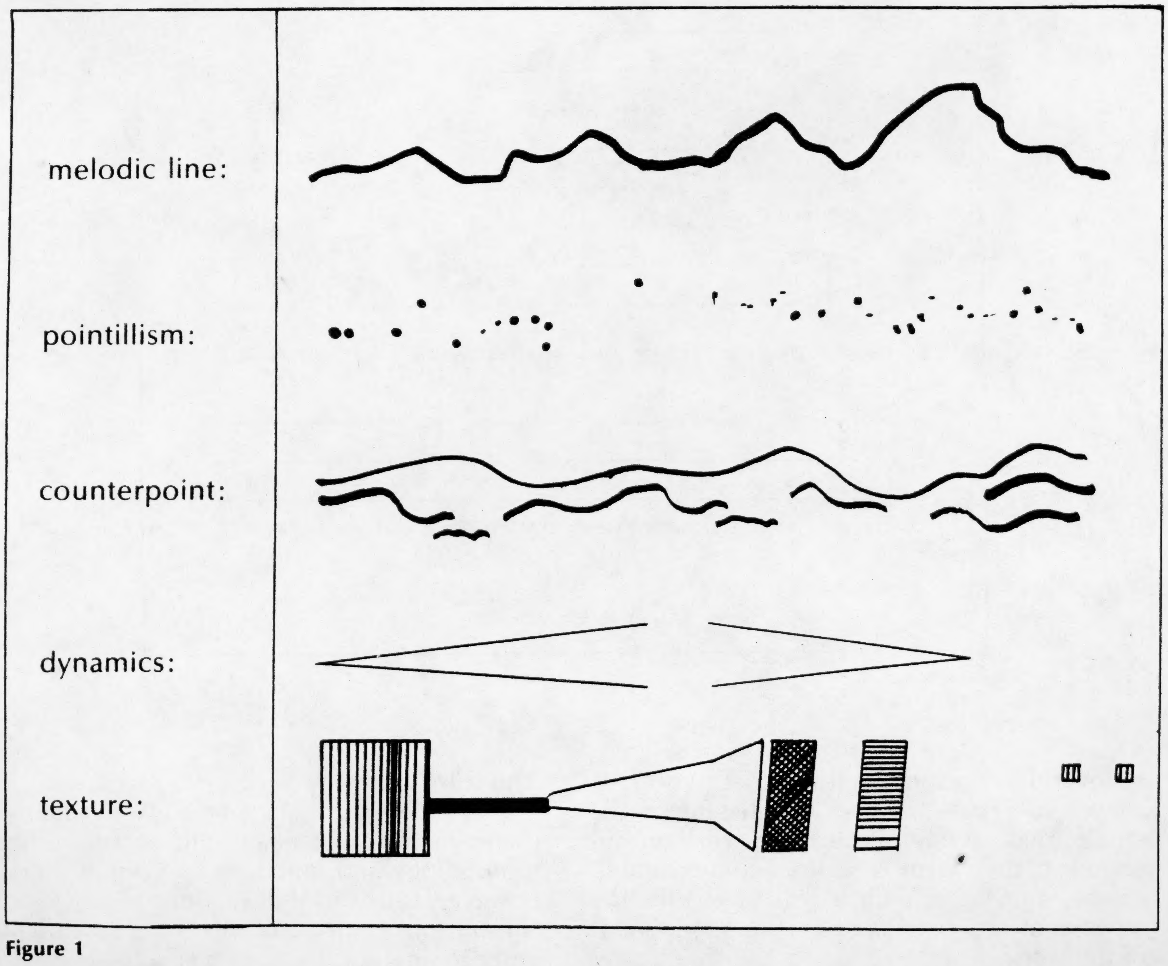


Figure 1

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[1] Recorded on Folkways FTS 33869.

FINAL EXAM REVIEW

Decibel ___ Name of measurement used to describe amplitude

Dub ___ A copy of another recording

Hiss ___ Background noise at a "high" pitch

ips ___ abbreviation used for the tape's running speed

mixer ___ A device which combines two or more inputs

attenuate ___ To decrease levels, as with volume

preamp ___ A device which boosts weak inputs such as mikes, guitar, etc.

Filtor ___ Another name applied to partial or overtone.

Hz ___ Name of measurement applied to frequency

Dropout ___ A momentary loss of volume from the tape playback

___ ~~A measure of ability to pass signals of different frequency without affecting their relative strength.~~

Capstan ___ A motor driven spindle that feeds tape at a constant speed

Crosstalk ___ Leakage of sounds from one channel into another

Amplify ___ To increase levels, as with volume

Hum ___ Background noise at a "low" level

phone ___ Type of plug that is used to patch in the synthesizer

sound on sound ___ Tape technique where the erase head is disabled

Distortion ___ Continuous tape "overload"

Feedback ___ A build up of energy due to an output signal getting back into the input of the system.

Wow ___ A slow variation in the speed of the tape

Tails out ___ Storage of tape on the take-up reel

Hub ___ The center section of a tape reel around which tape is wound.

bulk erase ___ The erasure of the entire tape

(over)